Pests

AND THEIR CONTROL

1942

SEPTEMBER

VOL. 10 NO. 9

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Pests

and Their CONTROL

COOPERATING WITH NATIONAL PEST CONTROL ASSOCIATION

Exterminators, Fumigators, Termite Control Operators, Entomologists, Insecticide and Supply Manufacturers

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"Contributed articles in this publication do not necessarily reflect the opinions of the editors. The editors invite discussions, comments and all types of literary material pertaining to pest control and pests from any person interested in the advancement of the field."

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EDITORIAL

Termite Treatise in Need of Revision

COINCIDENT with working out its economic problem, the termite in turn has created a sizeable one for mankind, the solution of which, in recent years, has engaged some of the best minds in the entomological profession, along with some of those in other groups with a contiguous interest. In consequence a great deal of light has been shed on the termite problem, with much more looming and only awaiting completion of research under way for some time past. Meanwhile, a rich fund of termite research literature has come into being, which, in the main, has been objective in approach and factually correct.

All of which is by way of a running preface to criticism of Dr. Victor W. Von Hagen's article, "NATURAL HISTORY OF TERMITES," which has found its way into the hands of a number of PCOs, and which appears sectionally in the June and July isues of The Scientific Monthly, published for the American Association for the Advancement of Science.

Because of the eminence of the publication source, in part, we fear there may be a tendency in some quarters to do some conclusion-leaping—as, indeed, we did ourselves at first—to the effect that Doctor Von Hagen's material is of great value to the PCO, when, as a matter of fact, the reverse is true.

Subsequent scrutiny of the text reveals that it is mainly a compilation, based on information much of which is out of date, that it deals principally with tropical species, and that it contains quite a few errors of fact, of which the most flagrant appear to be: **Reticulitermes,** a genus, is referred to as a species. Page 29, fig., **brachypterous** form is **not** the commonly accepted form. A termite described by Dr. Thos. E. Snyder (fig. page 34) is remarkable for having both "beak" and "jaws," as well as "sickles" on fore legs and which he named in 1924 **(Armitermes (Rhymchotermes) perarmatus)** "thoroughly armed"; Doctor Von Hagen completely misses the point that this is an intermediate form between the "beaked" and the "jawed." Page 37, "lumber from the United States has brought in the heartwood of 'Southern sugar pine' a North American termite to Europe"—there is no southern sugar pine; it is very debatable if an American termite has been introduced into Europe or vice versa. The termite on St. Helena is a native species. Page 38, the Termite Investigations Committee was formed in 1928, not 1927.

Moreover, because much fresh water has passed over the dam since, we are of the opinion that Doctor Von Hagen's article would have been more timely if he had not unduly emphasized, particularly at this late date, the work done on the termite problem in California in 1934, as correlated in the book, "TERMITES AND TERMITE CONTROL," which was top-heavy in certain of its editorial aspects. And finally, conspicuous by its absence from his text is any reference to the 1-2-3-3½ standard of subterranean termite control which has received authoritative recognition.

Termite Services Exempted From Price-Ceiling Regulations

ON THE grounds that they had "little relation to the cost of living," termite services were eliminated from the price-ceiling regulations by the Office of Price Administration as of August 12.

Charges for termite services were formerly controlled by specific service-price ceilings or by the general maximum price regulation prescribing use of the highest prices charged in March, 1942.

The revised regulation requires firms offering other types of pest control service to fix their rates by using the same pricing methods they used in March. If no pricing method used in that month fits the service now offered, the sellers must determine a maximum price by:

1. Using the highest price charged for the same service supplied in March.
2. Using the highest offering price for the same service in March.
3. Using the highest March price for a similar service supplied.
4. Or using the highest March offering price for a similar service.

If none of these is applicable, the seller is permitted to establish his price according to those charged by competitors.

Infestation Lowers Morale in War Effort

THAT the essential nature of pest control, or the lack of it, is a factor—as it is—in maintaining troop and civilian defense morale is forcefully demonstrated in a recent news comment in the country's largest circulating daily, which declares that "Among the hotels taken over by the Army in Atlantic City, was one so overrun by insects (in the kitchen) that that part of the building was rejected . . . Locally, a group of air raid wardens will be disciplined for insubordination because they refused to occupy vermin-infested headquarters."

At this distance, naturally, it is difficult to analyze the causes of the infestation indicated, but we'll wager all our unused sugar-ration cards, that they are compounded, in part, of faulty control chemical logistics. Urgent reason, therefore, to make available at once necessary supplies to help insure a successful second front of high troop and civilian defense morale, without which the war effort must lag.

Men in Armed Services

LOU GATTO, General Chairman of our 10th Annual Convention, which is definitely to be held at William Penn Hotel, Pittsburgh, Pa., October 26-27-28, has suggested that we open our Convention by unfurling at the time of singing the Star Spangled Banner a Service Flag that will show the number of PCOs in the various Armed Forces of our Country. Will you not co-operate by sending us the names of all employees who are in the service of the Army, Navy, Marines, Coast Guard, Air Forces, etc., listing at the same time their status.—N.P.C.A. Service Letter No. 256.

The foregoing applies to non-members of the Association as well. So let's hear from you, please.—EDITOR.

Transportation to Convention

THE INDUSTRY'S most efficient one-man office of transportation information, Martin T. Meyer, has passed along some thoughts relative to convention transit facilities. This year, he indicates, for familiar reasons the railroads will be the most accessible mode of travel for those convention bound. Since Pittsburgh, the convention city, is also the hub of the Pennsylvania R.R. System, it is the preferred road to use from New York and the East, Cleveland, Detroit, Chicago, St. Louis, Cincinnati, and other Mid-Western points, with trains leaving at convenient times. From Buffalo, the New York Central is recommended.

Connections from the Twin Cities and Milwaukee are recommended via the Chicago and Northwestern's "400," or the "Northwestern Limited"; from San Francisco, Omaha and other Iowa points, the "Challenger," or the San Francisco Overland Limited; from Kansas City and Los Angeles, the Southern Pacific-Rock Island's "Californian"; from Texas points, connecting at St. Louis, the Missouri-Kansas-Texas lines.

Those coming from Atlanta are advised to travel via Washington; those leaving from Birmingham, Nashville, and Memphis will find the Louisville and Nashville and Pennsylvania Railroads, via Cincinnati, the most convenient.

Publication of train schedules would be of no avail due to rather frequent changes being made therein, often by only a matter of a few minutes either way. It is important, therefore, that all persons who intend to travel by rail should check with their local passenger agent as to schedules and fares prevailing; if Pullman travel is anticipated, reservations should be made AT LEAST THREE WEEKS BEFORE THE CONVENTION DATE—October 26, 27, 28.

As always, Mr. Meyer, Transportation Chairman, whose address is 231 S. 10th St., Philadelphia, Pa., will be only too pleased an answer further mail queries on convention transportation.

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Buy War Bonds and Stamps

The Brown Dog Tick, an Important House Pest

Known scientifically as Rhipicephalus sanguineus (Latr.)

By F. C. BISHOPP, *Assistant Chief of Bureau of Entomology and Plant Quarantine, United States Department of Agriculture*

THE problem presented by the brown dog tick is admittedly one of the most troublesome with which the exterminator must deal. Furthermore, it is a problem of ever widening distribution and increasing frequency of occurrence.

With all this, relatively few of those actually carrying on pest-control work throughout the country have a sufficient knowledge of the appearance, life history, and habits of the pest to diagnose the problem adequately when it is encountered, to give their clients proper information regarding it, or to deal with it effectually.

This article is intended to help supply these desiderata in the tool bag of the pest control operator. However, the author must make it clear, at the outset, that he knows of no royal road leading to the extermination of this pest under the varied conditions in which it is encountered.

How to Recognize the Brown Dog Tick

The brown dog tick is essentially a house and kennel pest. It must suck blood in order to grow and reproduce. It feeds only upon dogs and very rarely attaches to man or other animals. It is capable of living a considerable period—even as long as seven months—without food.

The brown dog tick is observed on dogs and around houses where dogs are kept, in several stages and states of engorgement that leads many to think that several kinds of ticks are present. This tick, in common with most other kinds of ticks, passes through four stages, namely, the egg, the larva, or seed tick, the nymph, and the adult—male and female.

The ticks may be seen attached to any part of a dog; they are present on the dog and/or on the walls and curtains and furniture near the dog's sleeping place. The engorged females frequently crawl to the ceiling, where they may be seen in corners or along picture molds, and here they may deposit masses of eggs that hatch into seed ticks. They are present and more or less active the year round. The adult males and unengorged females are brown and devoid of white markings.

The brown dog tick is so often confused with the American dog tick (known scientifically as **Dermacentor variabilis Say**) by pest control operators and in the minds of the public that, in addition to pointing out the foregoing characteristics, it seems desirable to contrast the two species as below:

BROWN DOG TICK	AMERICAN DOG TICK
Seed ticks, nymphs, and adults found on dogs.	Adults only found on dogs.
All stages common in buildings.	Adults only occasionally found in buildings.
Seed ticks and nymphs feed on dogs only.	Seed ticks and nymphs feed only on small wild rodents (field mice, etc.).
Ticks found on dogs and in buildings the year round.	Ticks found on dogs during spring and summer (most abundant in May and June).
Ticks seldom found out of doors. Not a wood tick.	Ticks usually found in woods and fields—a true wood tick.
Ticks rarely attach to man.	Ticks commonly attach to man.
Ticks often found between dog's toes.	Ticks seldom attach between toes.
Not a carrier (to man) of Rocky Mountain spotted fever.	The carrier of Rocky Mountain spotted fever in the Central and Eastern States.
Male and female without white markings.	Male and female with white markings on shield on back.
Adults with angles projecting on each side of base of head (basis capituli).	Adults without lateral angles on base of head.
Unfed adults very active.	Unfed adults less active.

The difference in appearance of the males and females of the two species is brought out in figures 1, 2, 3, and 4.

Stages and Life History of the Brown Dog Tick

The eggs are oval, shining, brown, and deposited in masses of 1,000 to 2,600 in some corner or other protected place (See fig. 6, showing eggs of the American dog tick). The incubation period ranges from 19 to 60 days, depending on the temperature.

The larvae, or seed ticks (fig. 7), hatch from the eggs and remain quiet around the egg mass for a few days, then usually scatter to some extent, especially when disturbed. They have six legs, are brownish, and are of about the size of a pinhead. Seed ticks can live for about 4½ months. If they find a dog, they crawl upon it and attach. In from 3 to 6 days they become filled with blood, are bluish in color, and about the size of a No. 8 shot. They drop from the dog and hide, often in clusters, near the sleeping place of the host. They soon become sluggish and molt their skins in 6 to 23 days, the time required depending much upon the temperature.

The nymphs, as the ticks are called after they molt from the seed-tick stage, are brown, somewhat larger than the seed ticks, and have 8 legs (fig 8). They rest a few days after molting and are then capable of crawling very fast. They can live without food as long as 2½ months in summer and about 6 months in winter. They attach to a dog, if one is accessible, and in 4 to 9 days become fully engorged. They are then ovoid, grayish blue, and about the size of a No. 5 shot. Again they drop off, seek a protected place and in 12 to 129 days molt to adults.

The adult males and females are brownish, often with the dark inner structures showing through. The back of the male (fig. 1) is covered with a hard shield, or scutum, while in the female (fig. 2) this shield covers only the forward one-third of the body, the rear portion being capable of

great distension as the tick fills with blood. Adult ticks are about one-twelfth inch in length and are very active after they have become hardened following the molt. They crawl about, especially at night, seeking a dog, and when one is found they soon attach. They may take hold anywhere but, especially in short-haired dogs, prefer the inside of the ears and the places between the toes. Mating takes place after a few days of feeding, the male usually attaching immediately beneath the female. The male does not enlarge much while feeding, but the body of the female distends greatly and becomes dirty gray or blue gray in color. The engorged female is about one-third of an inch in length. (See engorged female of the American dog tick, fig. 5.) The females seek protected places when they leave the host. Often they crawl behind baseboards and casings, or up the walls to corner moldings.

Egg laying begins in 3 to 38 days, depending upon the temperature. The eggs are pushed out in front of the tick, which gradually shrinks in size, turns yellowish brown, and dies soon after its 1,000 or 2,600 eggs have been laid. This takes about 2 weeks.

How This Tick Enters Dwellings and How It Spreads

The brown dog tick is a tropical and subtropical species. It was first found in this country in extreme southern Texas. Later it was found in Florida, and during the last 25 to 30 years it has spread northward and now is widely distributed, especially in the larger cities. Although this pest can not successfully overwinter out of doors in the Northern States, it finds conditions in heated homes, apartments, and kennels favorable for its continued breeding.

The spread of the brown dog tick has been greatly favored by the frequent transfer of dogs from infested southern areas to northern cities. Infested kennels have been one of the main factors in accelerating local spread. Frequently a dog is sent to a hospital or kennel for a short time, then brought home with a few unnoticed ticks upon it. Under such circumstances, it may be weeks or even months before the infestation builds up and is noticed. By that time the pest may be scattered about the premises and firmly established.

Ticks may be dropped or scratched off by dogs on the street or in parks, but infestations, especially in the North, are not usually picked up from such sources.

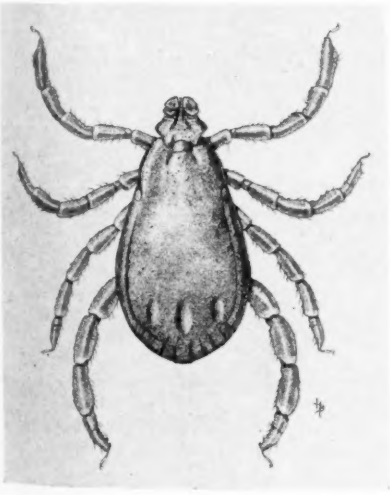

Fig. 1.—Brown dog tick; male. (Much enlarged.)

Fig. 2.—Brown dog tick; female, unengorged. (Much enlarged.)

Where The Brown Dog Tick Is Found

The brown dog tick is more abundant and widely distributed in the South than in the North. This is particularly true of Texas and Florida. In the South it is not uncommon to find heavy infestations in outbuildings where dogs sleep, in dog houses, and in trees and fences as well as under and on porches and in houses. In more northern localities outdoor infestations are less common and the trouble is more restricted to living quarters, basement areaways, and porches. In the summer, however, where dogs are frequently kept in outhouses and yards, rather heavy infestations may occur in such situations.

These ticks are always closely associated with dogs or occur where dogs have been kept. Out of doors the ticks occur in kennels, on the trunks of trees, in protected places on posts and gates, and even in the grass. Porches and adjacent walls and entryways to basements often become heavily infested from dogs that sleep in such places.

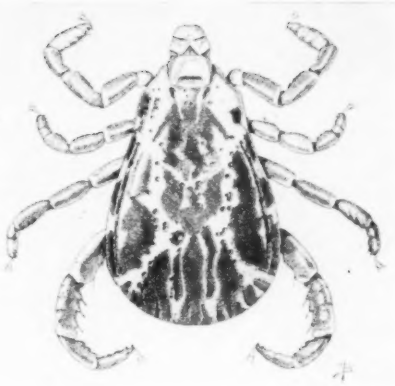

Fig. 3.—American dog tick, or wood tick; male. (Much enlarged.)

Indoors, also, the ticks are usually concentrated near the dogs' sleeping places. They are found on walls, picture frames, and curtains, behind baseboards, on door and window casings, in upholstered furniture, under table tops, and even in beds. In boarding kennels the pens as well as the buildings often become infested. This is true also of poorly kept dog and cat hospitals. The cracks in cages, especially in those built of wood, the spaces behind baseboards, and the walls, especially in the corners, may harbor ticks of all stages.

Control of the Brown Dog Tick

From the life history and habits of the brown dog tick as just described, it is evident that the pest must be attached on the dog and in the infested quarters, both indoors and out.

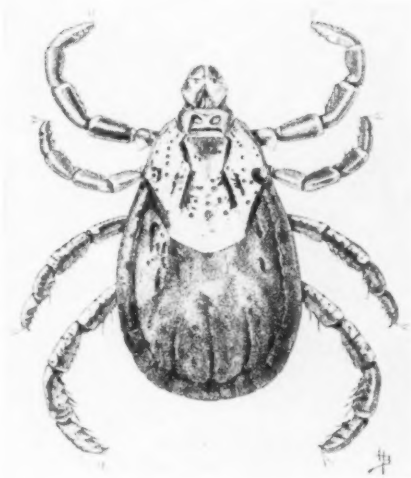

Fig. 4.—American dog tick; female. (Much enlarged.)

The exterminator's aim is to eliminate the ticks from the premises. He may hesitate to apply insecticides to a dog, but he must either do that or get the full cooperation of the dog owner in either treating the dog himself or getting a competent veterinary to do so. The exterminator must be prepared to advise those concerned as to the best methods of ridding the dogs of ticks and to see that dogs are treated at the same time as are the buildings or premises.

Probably the best method of killing the ticks on a dog is to apply a wash consisting of 2 ounces of derris or cube powder (containing 3 per cent of rotenone), 1 ounce of neutral soap or soap flakes, 1 gallon of tepid water. The animal may be placed in the dip or the material may be applied as a shampoo and rubbed in. The surplus liquid may be taken off with a towel and the rest allowed to dry on.

The ticks may also be killed by dusting the animal with derris or cube powder (containing from 3 to 5 per cent of rotenone) or fresh pyrethrum powder. The dip is preferable, however, because it insures more thorough distribution and it kills the ticks more quickly. It should be remembered that rotenone-carrying materials are slow killers, and that they are injurious if they get into the dog's eyes. On account of war conditions the sale and use of rotenone-carrying materials has been restricted. In fact, under the present War Production Board Order (M-133), such materials are not permitted for use on dogs for the control of the brown dog tick unless they have already been packaged specifically for that purpose. Pyrethrum powder, referred to above, may be used as a substitute and arsenical tick dips diluted so as to contain .18% arsenic trioxide may also be used against the brown dog tick. These dips are manufactured by a number of different companies and the dilution is usually indicated on the containers. Care should be taken not to dip the dogs if they have become overheated and they should not be closely caged or kept very quiet until the dip his entirely dried. This is for the purpose of avoiding scalding of the skin on certain tender portions.

If all ticks on the premises are killed, one application to the dogs is sufficient, but it is seldom that a single treatment of any kind will completely free premises. When ticks are present on premises, a dog must be treated every 4 or 5 days if all tick engorgement is to be prevented.

Fig. 5.—American dog tick; engorged female. (Enlarged.)

Fig. 6.—American dog tick; female and egg mass. (Enlarged.)

Fumigation

Fumigation of infested buildings is usually not recommended because it is often difficult to gas all places where the ticks occur, as on porches, in entryways, etc.

The brown dog tick is somewhat more difficult to kill with fumigants than are most insects. This is particularly true of the engorged nymphs and engorged adult females. In a well constructed and sealed building, a charge of 16 ounces of sodium cyanide to 1,000 cubic feet of space for 12 hours should give a complete kill in most instances.

Sprays and Dusts

Strong pyrethrum-kerosene sprays are effective if the ticks are wet with the spray. The main difficulty, however, is in reaching them all, for they are often secreted deeply in cracks, behind baseboards, or in protected places around furniture. The spray should be directed behind baseboards and trim and into all the cracks and crevices. It is also well to blow fresh pyrethrum powder liberally into such places.

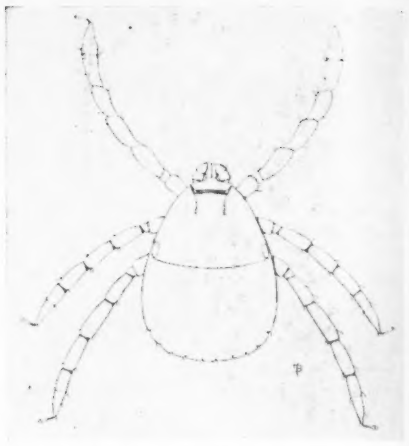

Fig. 7.—Brown dog tick; larva, or seed tick, unengorged. (Greatly enlarged.)

As a rule it is best to spray infested places three times at intervals of about 4 days, coincident with the treatment of the dog.

For outdoor treatments, spraying with creosote oil is most effective, if painted surfaces and shrubbery, which might be damaged by creosote, do not interfere. Creosote oil is especially useful in infested dog houses and outbuildings and on infested posts in the yard. Dogs should be kept out of a yard so treated until the creosote is thoroughly dried in, and care should be taken to prevent the material from getting on grass and shrubbery and on the face and body of the operator.

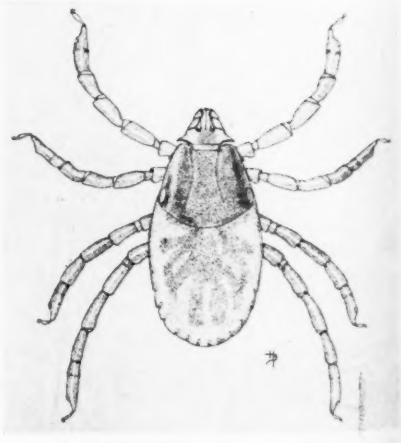

Fig. 8.—Brown dog tick, nymph, unengorged. (Greatly enlarged.)

Pest Control Exhibit at Muncie Fair Sponsored by Hoosier PCO, Proves Good-Will Gold Mine

ESCHEWING completely the direct solicitation of business, even to the extent of not obtaining names for his prospect list, but concentrating rather on the educational aspects inherent in pests and their control at his booth at the Muncie Fair, the first week in August, Bert Lewis, Lewis Pest Control, Muncie, Ind., found that his exhibit not only attracted an endless stream of visitors but stimulated many questions—in fact, so many questions had to be answered, that both he and Mrs. Lewis, his second in command there, had to maintain an extra supply of throat lozenges to ease the strain on their vocal cords.

Of supplementary and instructive interest is some of the outstanding booth detail, which the illustration, herein shown, does not quite bring into focus. For instance on the counter, in front of Mr. Lewis, were crystal glass-topped jars with a few live specimens in each of the following: three kinds of roaches, bedbugs, confused flour beetles, carpet beetles and larvae, moth, bean beetles, termites, in both winged stage and worker stage, and a house centipede. Mr. Lewis sat at the table explaining the identification of these insects to the housewives, who appreciated this, inasmuch, as many had never seen the live insects—especially the bedbug—and they felt, therefore, that the explanation gave them a basis for determining what their infestation was before it reached too critical a stage.

Another feature which attracted lots of interest was the display of fumigation gases, gas mask and warning signs, as did his rack of mounted specimens of butterflies, moths and beetles.

In the rear of the booth was a large display card, measuring 4x6 feet, containing illustrations of some of the common and unusual household pests, blown up to many times their normal size, which gave the audiences a better perspective of the insects' contours and shapes.

Much praise is due the Lewises for their constructive spirit as evidenced by their not inconsiderable financial outlay for booth rent; and, for their unremitting spade work—all of which, unquestionably, not only upped respect for the Industry, but which should also tend to create an added incidence of business opportunity.

"With the Colors"

Private Alexander J. Roublick's address is 920 A. F. R. T. C., Hotel Shelburne, Atlantic City, N. J. While in the service the Roublick Exterminating Co., located in the Bronx of New York City will continue operations under the direction of his wife and competent employees.

Lieut. Charles Partlow has transferred from Fort Bragg to Camp Bowie, Texas. They tell us that Charlie will be busy with tank destroyers.

Lost U. S. Fliers Fought Rats

A party of American airmen finally has arrived at an Australian base after spending two months lost in the wilds of New Guinea, the Australian radio announced, as heard by CBS.

The group consisted of the crew of a bomber forced down in a remote mountainous area, and men from three rescue planes. The first rescue plane cracked up, killing the pilot. The other two planes landed, but were unable to take off.

A RAF pilot sighted the Americans and directed them to a large airfield where they were finally picked up. Lieut. L. C. Doan, one of the Americans, said they had to post sentries each night with a rifle and flashlight to protect them from rats.

—*N. Y. Post.*

Fence Posts Preserved While Green

Can be set at once, and a lifetime of 15 or more years is assured, Oregon State College reports after extensive experiments. A three-quarter-inch slanting hole is bored in the green post about six inches above the ground line. A tablespoonful of preservative is poured in and confined with a cork or wood plug. Two holes are needed for the eight-inch posts; three for twelve-inch. The preservative, which costs about six cents a post, consists of equal parts by weight of corrosive sublimate (mercuric chloride), arsenic, and common salt. Commercial grades are satisfactory. The treatment, halting both decay and insect boring, must be used on green wood, because the sap dissolves the chemicals and carries them through all parts of the wood.

—*Country Gentleman, June,* 1942.

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PYRETHRUM vs. ROACHES

By DR. F. L. CAMPBELL, *Ohio State University*

Part 2

BECAUSE the susceptibility of different species of insects to pyrethrum varies, it is desirable that the performance of pyrethrum insecticides that are to be used against roaches should be determined against roaches. As the principles of biological evaluation of insecticides are the same regardless of the insecticide or of the species of test insect, it does not seem necessary here to go into great detail on the mechanical aspects of the tests that have been proposed. It should be pointed out only that the value of a test depends on the reproducibility of its results and on the relation of those results to conditions of practical use of the insecticide. Reproducibility of results depends on the number and uniformity of the test insects and on the uniformity of all experimental methods and conditions.

Pyrethrum Powder

According to McDonnell et al. (1920), Glover, in 1864, described the first experiment in the United States on the insecticidal efficiency of pyrethrum. Glover is quoted as follows: "This powder had a curious effect on some Croton roaches we were experimenting with; when sprinkled over them or placed in a circle and they made to pass over it, for a few steps they appeared very lively, but some staggered, and after a few struggles fell over and soon ceased to live." This is of historical interest, but of course Glover did not attempt to find out whether one powder was better than another. Another early use of roaches as test insects for pyrethrum is that of Unger in 1888, cited by Gnadinger (p. 88, 1936).

Little serious effort has since been made to evaluate pyrethrum powder on roaches, perhaps because chemical methods for the determination of pyrethrins in pyrethrum powder became available before a need for careful biological evaluation was felt. Chemical methods are satisfactory for straight pyrethrum powder but may be inadequate for mixtures containing pyrethrum.

The testing of pyrethrum powders against roaches has been carried out either by dusting the roaches directly or by causing them to run over a surface on which the powder is distributed as uniformly as possible.

The use of direct dusting requires arrangements for depositing the same quantity of powder per unit area on each roach. Hockenyos (1936) assumed that he could control this quantity by applying the maximum amount that would adhere to the insects. Great variation in deposit probably resulted. Worsley (1936) made a greater effort to control deposits. He placed 10 roaches in a glass dish (bottom covered with filter paper) and then blew into the dish 0.1 gm. of finely ground powder. The dish was gently shaken at all angles to make sure that each insect came into good contact with the powder. His observations consisted of the sum of marks given each individual at frequent time intervals. The greater the effect, the higher the mark, ranging from 1 (obviously disturbed and very active) to 10 (dead). When all ten insects were dead the sum of the marks was 100. In the writer's laboratory Gilbert (1941) used a more precise direct dusting method than either of the above. A weighed charge of dust was blown up into a tall, insulated, celluloid cylinder in which it settled uniformly on German or American roaches in a container at the base of the cylinder. The roaches were exposed to the settling dust for a definite period of time and were allowed to run around in the dusted container for another brief period. They were then transferred to clean containers for observation on the per cent paralyzed and dead at frequent time intervals. Having acurate control of dosage, Gilbert succeeded in showing consistent differences in effectiveness in samples of different pyrethrin content.

At least as early as 1937, R. E. Heal of Rutgers University was testing powders against the German roach by forcing it to run over a dusted surface. His methods and results were not published. Results obtained by a similar method were published by Laudani and Sweetman (1941). American and German roaches were induced to run along the bottom of a paper trough 2 inches wide and 14 inches long. The bottom of the trough was covered as evenly as possible with about 4 grams of powder distributed from a salt shaker. While this setup is adequate for demonstrating gross differences in effect in different materials, it lacks desirable uniformity in deposit and in provision for giving each insect the same period of exposure to the treated surface. Direct dusting of caged roaches was also done without dosage control. The experiments served to show that pyrethrum powder is effective only when the insects are dusted directly. This is understandable for Hockenyos (1936) had previously indicated that the quantity of pyrethrum powder picked up by a roach on running over a dusted surface is insufficient to kill it. For evaluation of straight pyrethrum powder a direct dusting method is therefore desirable. It should be supplemented by a runway test when sodium fluoride or other protective insecticides are mixed with pyrethrum or are to be compared with it. However, a better runway test than that described by Laudani and Sweetman should be devised, if good control of dosage and exposure is to be obtained.

Impregnated Powders

While so-called inert dusts impregnated with pyrethrum extract are used for control of agricultural insect pests, they have not yet been much used for roach control. It is curious, therefore, that the first serious application of roaches as test insects for pyrethrum involved the testing of impregnated powders. Staudinger and Rusicka (1924), wishing to check their chemical work on the isolation and identification of the active principles of pyrethrum, treated German roaches with impregnated powders. According to Gnadinger (p. 119, 1936), "The pyrethrins were dissolved in ether, which was then mixed with flour, with gentle warming on a water bath, until the ether was evaporated. Five to six roaches were placed in a flask and dusted with a spoonful of the powder." Pyrethrum powder was used as a check. While this crude method of application suited their purpose, a more precise method, like

that of Gilbert, described above, should now be used for impregnated powders. Incidentally, Gilbert's best sample was an impregnated (fortified) pyrethrum powder.

Pyrethrum Extracts

The evaluation of pyrethrum extracts, usually in solution in kerosene, against roaches has been attempted by many workers. The methods employed may be divided into two classes: (1) treatment of individual insects by injection, oral administration, or the application of drops or spray to the surface of the body, (2) application of a spray or settling mist upon groups of insects.

Treatment of individual insects is possible and undoubtedly could give good results, but in no case mentioned below has such a method been extensively employed by its originator or been used by others.

Saling (1928) was the first to propose a roach test for the evaluation of pyrethrum extracts. As already mentioned, this test involved the oral administration of measured volumes of mineral oil extracts of pyrethrum to American roaches. No comparative results were given.

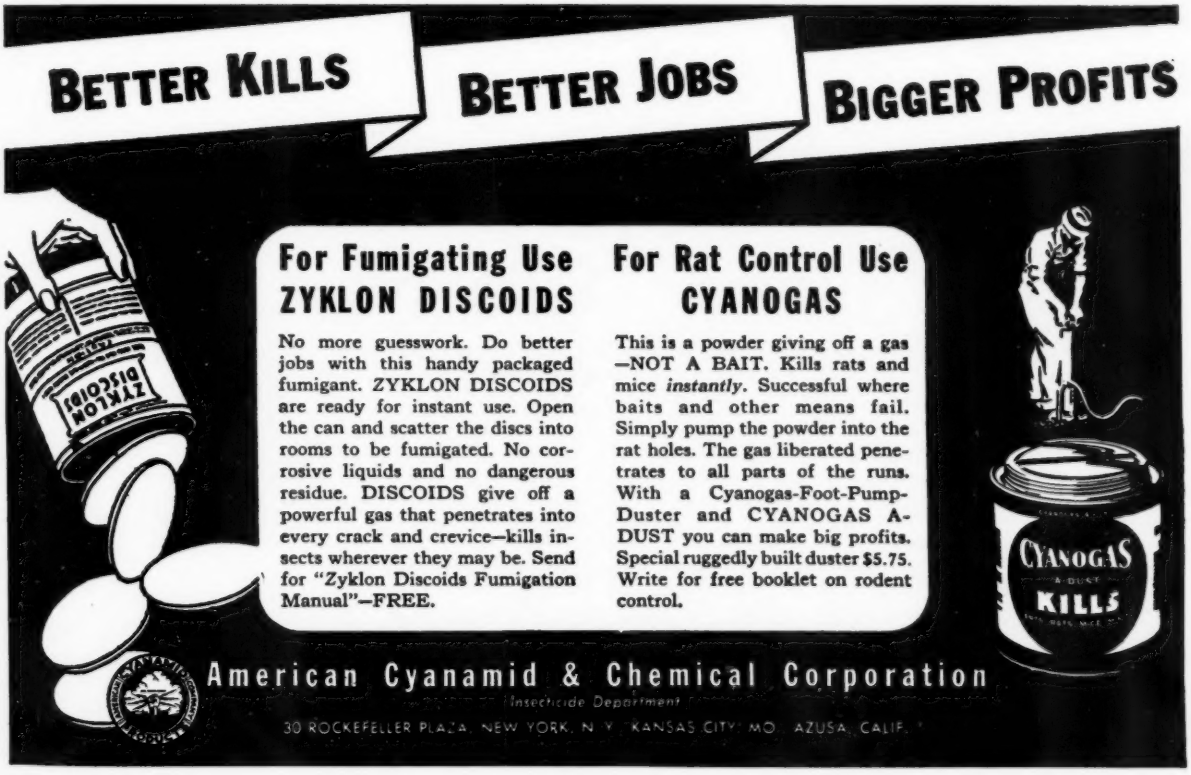
Buchmann (1930) extended Saling's work to include oral injection and subcutaneous injection of oil solutions into the giant roach and the American roach. He described the effects of the injection, showed that effects are related to dose, and suggested noting the time of paralysis as a criterion of effect, but, like Saling, he did not give comparative results. Both methods are therefore merely suggested techniques that were not utilized.

The Insecticide Standardization Committee of the National Association of Insecticide and Disinfectant Manufacturers (Anon. 1932) presented a report on a "roach test" method for evaluating pyrethrum extracts. The procedure called for spraying individual German roaches under standard conditions and for criterion of effect taking the time from application till the roach "lies on its back and is unable to regain its feet" — the so-called "paralyzing time." An example is given to show that paralyzing time is inversely proportional to the concentration of pyrethrins and that unknown samples give various results within the range of the known samples. Again we have the basis for a method, but no demonstration of its utility or reliability is given. While the criterion of "paralyzing time" is satisfactory for pyrethrum sprays, it alone is not sufficient for comparison of pyrethrum sprays with other sprays that may have a poor paralytic effect but a good lethal action.

Nelson et al. (1934) proposed the placement of measured drops of oil base insecticide diluted with absolute ethyl alcohol on the center of the thoracic sternum of chilled, adult German roaches. After treatment the insects were placed in glass dishes with food and water and mortality counts were made after 24 hours. If 100 selected roaches per sample were used and the same dose was applied to each, the difference in effectiveness of two samples was represented by the difference in percent mortality. However, no results with roaches are given. For general test purposes this is the most promising of the foregoing methods involving the use of individual insects, although it gives no information on paralyzing time.

It is easier to spray groups of roaches than to treat individuals—if one has a large supply of roaches.

The first group spray tests of pyrethrum-oil involving roaches were made by Abbatucci and Roubaud (1926). Three samples were compared against German and oriental roaches on the basis of time to total paralysis or apparent death. The results were so variable that no conclusions could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be drawn. Information is lacking for judgment of the value of the method.

Worsley (1936) published results of a few tests of a pyrethrum-oil spray against roaches made under standard conditions which are not completely described. Only 10 insects per test were used. The results show only that per cent mortality depends on concentration of pyrethrins.

Undoubtedly the first investigator to use large numbers of roaches as test insects for pyrethrum-oil and other liquid insecticides was Tuma (1938). At the time of his publication he claimed to have reared and killed more than 2,000,000 German roaches during a period of three years. In his paper he describes all the precautions that should be taken to rear uniform insects of known age (sex of insects was not mentioned, however), to apply a known volume of spray in a uniform manner under controlled conditions and to make objective counts of roaches down (moribund or dead) in 1, 24, and 48 hours. It is sufficient to say here that roaches in a large glass jar were subjected to direct spray and settling mist. At the time of the 1 hour count all roaches were transferred to a clean smaller jar with food and water. Unfortunately Tuma has never published results of comparative tests of different samples made by this method, but judging from his published results on the relation of age to susceptibility, the method should be satisfactory.

Recently McGovran and Fales (1942) have made an important contribution to technique of direct spray tests against German roaches. In order to control dosage accurately, the spray from a fixed nozzle above a rotating cage of roaches is interrupted by a partition that swings like a pendulum. The hole above the roaches is open to the spray only when the partition is at the extremities of its swing. Thus the dose is determined by the number of swings of the partition.

The writer and some of his students have been engaged in the development of roach tests since July, 1937, working with the National Association of Insecticide and Disinfectant Manufacturers and some of its members. A description of three group methods is given by Campbell, Barnhart and Hutzel (1941). As reprints are available for distribution, only the principles of these methods are outlined here.

(1) In Barnhart's settling mist method a definite volume of insecticide is sprayed into a tall, insulated celluloid cylinder. After the mist in the closed cylinder has ceased swirling and has started to settle, roaches in a container at the base of the cylinder are exposed to the settling mist for a definite period of time. In this way deposit of insecticide on the roaches is precisely controlled.

(2) In Barnhart's lard can method roaches in a standard perforated concealment box are sprayed with a definite volume of insecticide. Those that emerge from the box are subjected also to settling mist. This method has proved to be particularly suitable for determining the relative activating effect of different insecticides, but it is undesirable as a general test method.

(3) In Hutzel's modified chamber method roaches are confined in several small crystallizing dishes, which are placed in fixed positions on the floor of a Peet-Grady chamber. These positions spiral out from the center of the floor, so that each position is farther removed from the center than the preceding one. When an atomizer is fixed at the top center of the chamber to spray down upon the roaches in these dishes, the spray cone as it strikes the floor does not cover all dishes uniformly. There is a fixed dosage gradient from the center to the outer circle, and therefore the mean dose received by each dish diminishes as its distance from the center increases. In this way a graded series of mortalities may be obtained with each treatment, thus obviating the excessively high or low kills that may be obtained by single dose treatments. Much data must be obtained by this method and studied statistically before it can be recommended for general use.

Pyrethrum for Roach Control

When, where, and how pyrethrum powder was first used for roach control is probably unrecorded. The earliest official recommendation of pyrethrum for this purpose that the writer has seen is to be found on page 93 of the bulletin on the principal household insects of the United States by Howard and Marlatt (1896). It would serve no useful purpose to cite all the subsequent bulletins in this and foreign countries in which similar recommendations have been made, because no practical experimental work with pyrethrum is described in any of them nor is the application of pyrethrum discussed in detail. For example, let us quote the latest recommendation of Back (1937): "Pyrethrum powder, used in the same way as sodium fluoride, is excellent when thoroughly applied to the hiding places or to the roaches themselves. They usually turn on their backs, and although they live for some time, they eventually die if thoroughly treated. The stupefied roaches should be swept up and destroyed several hours after treatment before those least affected can revive. Pyrethrum powder is a safe remedy and will not injure man or pets. Upon exposure to air it loses its effectiveness after some days, and only fresh, finely ground powder should be used. It can be most thoroughly applied by means of an electrically operated dusting machine."

The foregoing recommendations are not based upon experimental work, but upon general experience, including opinions of pest control operators. Actually we do not know in a single instance how well pyrethrum powder will control a given roach infestation, when applied in known quantity and manner under known conditions. Contrast this situation with research and recommendations on control of agricultural crop pests. Field experiments may be made year after year on comparable plots before recommendations are made and recommendations are revised from time to time as new information is obtained. We have no such background for roach control. We know only that if we can place enough pyrethrum powder on every roach in an infested building, the infestation will be eliminated until eggs hatch or new roaches enter or are brought in. But we can get facts on the value of pyrethrum for roach control. It is worth while, therefore, to consider the design of an adequate "field test."

Suppose that we have a kitchen heavily infested with German roaches —the site of our field test. We wish to know the degree of control that we can obtain by the application of a fresh, air-floated pyrethrum powder containing 1.3 per cent pyrethrins. The first step is to study the infestation and estimate its intensity. This might be done by taking flashlight photographs in the dark kitchen and counting roaches showing in different views. During the daytime a weak pyrethrum spray may be used to locate infested cracks and further to estimate the population of roaches.

Worst Since 1938

The warning of the worst mass flight of mosquitoes since 1938 was given, the middle of August, by George W. Eager, superintendent of the New Jersey Mosquito Commission. He estimated 1,250,000 persons, in Essex, Morris, Passaic and Union Counties, New Jersey, would be the targets of the raiders. Eager explained that 20,000 acres of flooded meadows of the Passaic River and its tributaries have been the breeding ground for the pests and that efforts to eradicate the eggs had failed.

For the record the infested cracks may be marked in sketches or photographs of the room. The construction of outside and inside walls and floors should be noted.

After having learned as much as possible about the existing infestation, we are ready to apply the pyrethrum powder by power duster, the rate of output of which is known. The powder will then be applied in the daytime in the previously located cracks, the quantity applied being estimated by timing. An observer will be stationed in the kitchen, in all rooms surrounding the kitchen and out of doors outside of the kitchen. These observers will take timed notes on the behavior of roaches in the kitchen and on the number and behavior of roaches seen to run into the surrounding rooms and out of doors. The observers will count the numbers of paralyzed roaches and will take samples of all stages to determine whether they will die or recover. Frequent inspections will be made thereafter to estimate the remaining infestation, its location and build-up. Finally we shall have the data needed to publish facts instead of opinions.

The experiment outlined above may seem ridiculous to a pest control operator who, when he takes a roach control job, cannot play with it, even if he could afford to do so. Yet there was a situation on this campus where the above experiment could have been carried out, and if entomologists had the financial support for household pest research that they have been granted for agricultural pests, it would be quite feasible to make many such field tests against household pests. It must be pointed out, however, that it is more difficult to make comparative field tests against household insects than it is against crop pests, because it is almost impossible to arrange adjacent comparable test plots indoors, whereas this is done as a matter of course in tests of insecticides against insects attacking orchards, truck crops, etc. So the road to factual knowledge of roach control with pyrethrum or other insecticides is long and arduous.

The degree of control that is obtained with pyrethrum will certainly depend on the nature of the hiding places and on the placement of an adequate quantity of powder in those hiding places so that the roaches will be dusted directly or will become dusted as they attempt to move through a dusted crack. Mechanics of construction and application are vital.

Of all organic insecticides, the writer believes that pyrethrum is most effective for roach control. Pyrethrum has an essential place in roach control because of its safety and because of its prompt spectacular effect on the insects. Properly applied in the right situations, it has given excellent results and if retreatments are made as needed, a roach population can be held down to a very low level. Unfortunately it lacks the lasting protective effect of sodium fluoride and phosphorus paste and may drive into unexpected places roaches that can escape.

Bearing in mind the fact that contact action on the body of the roach by a sufficient quantity of available pyrethrins is necessary to cause its death, one may expect improvement in roach control to result from any means that will facilitate or increase this contact with pyrethrins.

The use of an impregnated (fortified) pyrethrum powder or an impregnated inert dust is indicated. It would seem desirable to lay down a thick band of pyrethrum powder all

(Continued on page 22)

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Five Fumigants for Disinfestation of Bedding and Clothing: A Comparative Study of Insecticidal Properties

By G. C. SHERRARD, *Senior Surgeon (R), United State Public Health Service*

FUMIGATION has been defined as the process of liberating fumes or gases with the object of destroying insects, rats, mice, and other small animals acting as vectors of infection. In view of the present potentialities for the spread of disease during the congregation of military and civilian populations, it has seemed timely and appropriate to re-examine the properties of some of the principal fumigants and determine these properties under test conditions. It may be, too, that there will be an increasing need for the extensive use of fumigants in disinfecting fabrics and clothing coming into the United States from infected foreign territory.

In this study attention was directed to a consideration of the effectiveness of several fumigants when used to destroy insects in clothing and bedding. The chemicals chosen were those which have shown evidence of value as insecticides and have been used with reported success by public health workers.

Fumigants Tested—The fumigants tested were hydrocyanic acid, chloropicrin, methyl bromide, ethylene oxide-carbon dioxide mixture in the proportion of one part ethylene oxide to nine parts carbon dioxide, and ethylene dichloride-carbon tetrachloride mixture in the proportion of three parts ethylene dichloride to one part carbon tetrachloride.

Points Considered—In testing each of the fumigants the following points were observed:

1. Minimum lethal concentration (MLC) for insects and rats.
2. Penetration of fabrics.
3. Time exposure required for killing.
4. Safety features.
5. Effect upon fabrics.
6. Temperature as it affected insecticidal qualities.
7. Methods of application.

Mechanical Equipment—The tests were conducted under laboratory conditions in a gas-tight steel chamber having a capacity of 11.037 cubic feet and provided with special inlets permitting the introduction of accurate quantities of the fumigant studied. Provision was made for obtaining a vacuum of 25 inches or more of mercury.

Experimental Conditions — In the tests for penetrating qualities, insects were placed between layers of blanket material folded in such manner that the gas would have to penetrate each separate layer before reaching the insects. The material was of a thin cotton-wool mixture averaging 16 layers to the inch when compressed by a pressure of 1/8 pound to the square inch of surface.

Vermin Used—The insects used in determining the efficiency of the fumigants were bedbugs (**Cimex lectularius**) and cockroaches (**Blattella germanica**). The wild rats were of the Norvegicus species. These particular vermin were chosen because of their reputed resistance to fumigants. In preliminary tests it was noted that bedbugs, in varying stages of development, exhibited no demonstrable difference in resistance when exposed to the fumigants. However, only those past the third molt were used. In the case of cockroaches the adults appeared to be more resistant than the young and for that reason only adults

TABLE 1.—The minimum lethal concentration and the concentration for a 100 per cent kill of bedbugs by each of five fumigants, in ounces per 1,000 cubic feet, under comparable conditions.

Fumigant	MLC for bedbugs in oz. per 1,000 cu. ft.			Hours of exposure	Fahrenheit temperature range	Concentration required for a 100% kill of bedbugs in oz. per 1,000 cu. ft.		
	Unprotected	Protected by 32 layers of blanket				Unprotected	Protected by 32 layers of blanket	
		Atmospheric pressure	25-inch vacuum				Atmospheric pressure	25-inch vacuum
Hydrocyanic acid	1/6	½	1/5	4	61° to 70°	2	4	192
Chloropicrin	3	4	4	4	65° to 72°	4	6	160
Methyl bromide	4	6	4	4	70° to 72°	6	8	6
Ethylene oxide mixture	80 at 85°	128 at 85°	80	4	80° to 85°	192	256	4
Ethylene dichloride mixture	88	192	128	4	70° to 75°	160	224	2

TABLE 2—The minimum lethal concentration and the concentration for a 100 per cent kill of cockroaches by each of five fumigants, in ounces per 1,000 cubic feet, under comparable conditions.

Fumigant	MLC for cockroaches in oz. per 1,000 cu. ft.			Hours of exposure	Fahrenheit temperature range	Concentration required for a 100% kill of cockroaches in oz. per 1,000 cu. ft.		
	Unprotected	Protected by 32 layers of blanket				Unprotected	Protected by 32 layers of blanket	
		Atmospheric pressure	25-inch vacuum				Atmospheric pressure	25-inch vacuum
Hydrocyanic acid	1/5	½	1/5	4	60°	2	6	2
Chloropicrin	3	4	3	4	65° to 76°			6
Methyl bromide	3	6	3	4	69° to 72°	5	6	5
Ethylene oxide mixture	80	128	80	4	79° to 85°	5	8	160
Ethylene dichloride mixture	48	64	48	4	63° to 70°	160 88	512 160	88

TABLE 3—The minimum lethal concentration of 5 fumigants, in ounces per 1,000 cubic feet, for the destruction of wild rats, under comparable conditions.

Fumigant	MLC for rats in ounces per 1,000 cubic feet (unprotected)	Hours of exposure	Farhenheit temperature range
Hydrocyanic acid	1/5	4	52° to 59°
Chloropicrin	1	4	63°
Methyl bromide	2	4	76° to 79°
Ethylene oxide mixture	80	4	80°
Ethylene dichloride mixture	88	4	73°

were used. A considerable variation in the resistance of individual bedbugs and cockroaches was noted, the greatest variation being found with hydrocyanic acid and the least with chloropicrin.

The results obtained in laboratory tests with the fumigants under stated conditions are shown in tables 1, 2, and 3.

To obtain the data shown in the tables, 139 tests were made. These ranged from a sublethal dosage with various conditions of exposure, temperature, and protection, to the maximum dosage necessary to produce a 100 per cent kill. In comparing the fumigants the period of exposure to which the insects and rats were subjected was set at 4 hours, for preliminary tests had shown that the reduced toxicity of some of the fumigants (ethylene oxide and ethylene dichloride mixtures) when applied for less than 4 hours could not be compensated by a proportionate increase in concentration. Quick action is of prime importance and a fumigant which is not capable of producing satisfactory results within 4 hours will be of restricted value. To the limit of 12 hours the effectiveness of all the fumigants was found to be in direct proportion to the period of exposure. No tests were made beyond that exposure period.

A comparison of the five fumigants led to the following observations:

1. The minimum lethal dosage of each fumigant shows no marked difference between bedbugs and cockroaches. The exposure of wild rats was made because it was believed that these animals would more nearly approximate human beings than insects in reaction to toxic gases. It will be noted that the greatest variation in the MLC between rats and insects tested was found in the case of chloropicrin. This is probably due to the irritating effect of the chloropicrin on the delicate lung tissue of rats, superimposed upon the purely toxic effect.

2. The tests indicated that the penetrating qualities of the fumigants followed very closely their molecular weights. Hydrocyanic acid and ethylene oxide-carbon dioxide mixture are the least penetrating to fabrics, having molecular weights of 27, 44, 44, respectively. All of the fumigants penetrated 32 layers of thin blanket material composed of a mixture of cotton and wool in a 4-hour exposure at atmospheric pressure. Chloropicrin appeared to penetrate fabrics more readily than any of the other fugigants. When a vacuum was not used, time was the essential factor in the penetration of fabrics by all gases. When a vacuum of 25 inches or more was used, penetration of 32 blanket layers was acomplished by all the fumigants. In this connection a series of tests was made with chloropicrin, using a commercial steel fumigating chamber of 2,500 cubic feet capacity. A complete kill of both bedbugs and cockroaches was obtained within the center of a commercial bale of cotton, the concentration being 16 ounces per 1,000 cubic feet, with a 4-hour exposure and a 28-inch vacuum. Following a technique described in a United States Department of Agriculture publication[1], the insects were placed in a hole drilled through the point of a long iron pin, which was then driven into the center of a bale of cotton by means of a sledge. Controls similarly placed but unexposed to gas were not injured.

3. **Toxicity**—In proportion to its concentration, hydrocyanic acid appeared to be the most toxic of the fumigants tested, although the spread between the minimum lethal concentration needed to produce a 100 per cent kill of bedbugs and cockroaches

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was very much greater than was found to be the case with the other fumigants tested. Chloropicrin and methyl bromide also gave a satisfactory kill within the 4-hour period of exposure. With ethylene oxide and ethylene dichloride mixtures a longer exposure was needed to obtain the full toxic effects under all conditions.

Delayed Effects—In observing the latent effect of the various fumigants on wild rats it was noted that when exposed to hydrocyanic acid they either died during or immediately after exposure or made a complete recovery, indicating that no delayed toxic effect resulted from exposure to the gas. With chloropicrin, when death of the animal did not occur during or immediately after exposure to a dosage approximating the MLC, symptoms of pulmonary irritation which lasted for several days were frequently observed. Rats recovering from such symptoms were observed for a period of 14 months during which period they appeared normal in all respects.

Following the exposure of rats to a MLC of methyl bromide, death was frequently delayed for a period of 1 to 3 days, with an occasional death much later. When recovery occurred, toxic symptoms persisted for a long time. Cockroaches and bedbugs exhibited the same delayed or prolonged toxic symptoms when subjected to a concentration of the gas considerably exceeding the MLC.

Rats exposed to ethylene oxide and ethylene dichloride mixtures in concentrations slightly less than the lethal dosage showed evidence of a delayed toxic effect by such symptoms as refusal to eat, inactivity, ruffed fur, unsteady gait, and a slow recovery extending over several weeks.

4. Safety—Since the safety of a fumigant depends upon the ease with which it can be detected by the human senses, this quality of the fumigants was closely observed. Chloropicrin was the outstanding gas in this respect, a concentration of one-sixteenth of the MLC being unbearable to humans because of its intense lachrymatory irritation. In its gaseous form this is believed to be the safest of all the fumigants tested, although the fumigator is subjected to the hazard of severe skin burns when handling chloropicrin in liquid form unless protected by rubber gloves. The fumigant presents no explosive or fire hazards.

Methyl bromide, highly toxic in its effects, has only a slight odor suggesting bromine and it is very difficult to estimate the gaseous concentration by the sense of taste or smell. Rats exposed to sublethal concentrations of the gas frequently exhibited no symptoms during the period of exposure but evidenced toxic symptoms 24 hours later as shown by reduced activity and refusal to eat. No irritation to the eyes was noted in minimum lethal concentrations. For these reasons it is considered particularly dangerous.

Neither ethylene oxide mixture nor ethylene dichloride mixture has sufficient warning qualities by which it may be readily detected by other than experienced fumigators. Frequent exposure of fumigators to sublethal concentration of these gases during the process of aeration may produce a cumulative toxic effect.

5. **Effect on Fabrics**—None of the fumigants in gaseous form were found to affect the color or texture of fabrics or noticeably to corrode metals. Samples of various textiles of both vegetable and animal origin were subjected to large quantities of the fumigants in gaseous form without any deterioration being noted.

6. **Temperature**—A low temperature was found to alter materially the efficiency of two of the fumigants, ethylene oxide and ethylene dichloride mixtures. For these fumigants a temperature of 80° F. or more was required to obtain a maximum result, although fair results could be obtained at temperatures as low as 65° F. Below the latter temperature ethylene oxide mixture was unsatisfactory. Ethylene dichloride mixture was found effective as low as 57° F. with only a moderate increase of dosage.

7. All of the fumigants mentioned may be obtained commercially in liquid form in steel cylinders from which they may be sprayed into fumigating chambers or compartments, under their own pressure or that of compressed air. With hydrocyanic acid and chloropicrin this method may be altered by distributing, from sealed cans, impregnated absorbent discs containing the liquid gas. These cans are light in weight, easily opened, and contain from 1 to 4 pounds of liquid gas, each disc representing about ¼ ounce.

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The application of methyl bromide and ethylene oxide and ethylene dichloride mixtures requires the transportation and use of heavy, cumbersome steel containers equipped with pressure gages, gas-tight valves, sprays, hose, etc., together with scales for weighing proper quantities for small chambers or compartments. With hydrocyanic acid and chloropicrin all this equipment may be dispensed with by the use of can type containers, thus resolving the problem into one of the comparatively easy transportation and simple application.

When the transportation of heavy apparatus or explosive gas presents a major problem in the disinfestation of bedding and clothing of the civil population or of the armed forces, it would appear that chloropicrin is the fumigant of choice. The exercise of a little ingenuity in converting small empty buildings, packing boxes, trash cans, tents, canvas bags, etc., into fumigating devices should permit the use of chloropicrin as a disinfestation agent under conditions which might otherwise be considered adverse.

Conclusions

The choice of a fumigant will depend upon location, time, space, equipment, transportation, quality, quantity, use to which the fumigated material is put, presence of trained operators, safety features, and the kind of insects to be eradicated. When so many factors must be taken into consideration, a comparison of the value of the fumigants tested is difficult and the results may vary somewhat according to individual judgment.

None of the fumigants tested were found to be ideal in every respect, and no single fumigant was superior under all conditions. However, in connection with bedding, clothing, and like textiles, it is believed that hydrocyanic acid and cholorpicrin are the fumigants of choice. As an insecticide, chloropicrin appeared to have the most desirable qualities. It is nonexplosive and has excellent warning characteristics in sublethal concentration. Rats exposed to slightly less than lethal concentration for a period of 4 hours show no evidence of permanent pathology. The objection to this gas is mostly concerned with the necessity for ventilation following fumigation. It clings persistently to fabrics, requiring either prolonged aeration, agitation, heating, mechanical ventilation, or some combination of these factors. Unless used in an isolated building, its irritating properties necessitate an exhaust extending above the surrounding buildings. None of these objections are so serious as not to be easily overcome in a commercial fumigating vault located in large centers of population or by isolating the fumigation chamber in field disinfestation of bedding and clothing.

It would appear that chloropicrin has considerable possibilities as a delousing agent for clothing especially when war conditions require such treatment on a large scale and when suitable apparatus for the application of steam heat is not available. Moore[2] and Moore and Herschfelder[3] report the destruction of both lice and eggs in 30-minute exposures using a concentration of 4 cc. to a cubic foot of space. The same results should be obtainable by greatly reduced concentration if the exposure were increased to a 4-hour period. The writer was able to obtain satisfactory kill of the eggs of bedbugs in a concentration of 12 ounces per 1,000 cubic feet of space with a 4-hour exposure.

From a toxic standpoint, methyl bromide is an excellent fumigant for bedbugs and cockroaches. It is non-

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explosive and presents no fire hazard but shows evidence of a delayed toxic effect in sublethal concentration. It is not readily detected by the senses of smell and taste. In comparatively weak concentration a toxic quantity may be inhaled without the victim being aware of exposure.

Ethylene oxide-carbon dioxide mixture proved effective as an insecticide when the test subjects were exposed to the full concentration of gas, but is somewhat deficient in penetrating qualities and requires prolonged exposure to produce results.

In comparing the relative toxicity of the ethylene oxide and ethylene dichloride mixtures, the kind of insects tested must be considered. A small percentage of both bedbugs and cockroaches proved to be extremely resistant to ethylene oxide mixture, necessitating a high concentration of the gas in order to secure a 100 per cent kill. On the other hand, a small percentage of bedbugs appeared quite susceptible to this gas. For cockroaches ethylene dichloride mixture appeared definitely more toxic than the ethylene oxide mixture. At temperatures below 65° F. the ethylene dichloride mixture was more effective than the ethylene oxide mixture. The low toxicity of both these gases coupled with the high concentration necessary in order to obtain a satisfactory kill of insects are undesirable features when large quantities of bedding and upholstery are to be fumigated.

No new data relative to the value of hydrocyanic acid gas were developed by these tests. In the absence of a vacuum this gas did not penetrate fabrics quite as readily as chloropicrin or methyl bromide. The absence of definite warning qualities in lethal concentrations renders it dangerous to life when used by inexperienced persons. However, its high toxicity, rapid evolution from a liquid to a gaseous state, coupled with the fact that the gas approximates the weight of air and thereby promotes rapid diffusion, makes it a valuable fumigant for eradicating rodents and insects from buildings and their furnishings.

Tests other than those mentioned indicate that in the case of hydrocyanic acid the residue gas remaining in fabrics following fumigation is much greater than formerly believed. Absorption and adsorption appear to play an important role in the ability of a fumigant to penetrate fabrics.

It is suggested that in addition to the processes of absorption and adsorption there may be a reverse chemical reaction between certain gaseous fumigants and fabrics derived from both animal and vegetable fibres, which may account for a portion of retained gas.

Acknowledgments

The author desires to acknowledge his appreciation to Dr. Robert Olesen, chief quarantine officer at the Port of New York, for advice and suggestions in the preparation of this article and to Administrative Assistant John J. Essex, of the United States Public Health Service, for assistance in completing the tests which are the basis of this report.

—Public Health Reports, 5-15-42.

[1] Technical Bulletin No. 63, U. S. Department of Agriculture.

[2] Moore, Wm.: J. Lab. and Clin. Med., 3:261-268 (1918).

[3] Moore, Wm., and Herschfelder, A. D.: Univ. of Minn. Research Pub., Vol. 8, No. 4, July 1919 (86 pages).

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A Natural Habitat for the Black Carpet Beetle

E. Gorton Linsley

On several occasions in the last four or five years the writer has found the black carpet beetle, **Attagenus piceus** Oliv., breeding in chipmunk nests in mountain cabins in the vicinity of Lake Tahoe, in Placer County, and Pinecrest, Tuolumne County, Calif. In the spring of 1941, Dr. T. H. G. Aitken encountered the species and **Anthrenus scrophulariae** (Linn.) under similary conditions at Manzanita Lake, Lassen County. Back & Cotton (1938) have also noted its ocurrence in birds' nests.

In Sierra Nevada summer resorts, occupants of mountain cabins have frequently reported injury by the black carpet beetle to woolens and other fabrics of animal origin, whereas the city homes from which the materials were transported were free from infestation. Since most of the cabins involved were known to have chipmunk nests within the building it seems possible that chipmunk nests may have served as foci for the infestations.

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—*Journal of Economic Entomology June, '42.*

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Synthetic Organic Compounds as Potential Insecticides

By L. E. SMITH, *Division of Insecticide Investigations**

XANTHONE: Laboratory insecticidal tests indicated that xanthone was toxic to the mosquito larva, the diamondback moth, and termites. It has recently been made available in quantity and has been tested against codling moth larvae and other insects under field conditions. Further experimentation to determine the proper modes of application, its compatibility with fungicides, etc., are necessary before any recommendations can be made for its use for the control of any insect pest.

Dimethylacridan was found to be toxic to the mosquito larvae, termites, etc. While it is commercially available, dimethylacridan has not been tested extensively under field conditions.

Penoxathiin (Phenothioxin.) Insecticidal tests have shown this compound (1) to be effective when tested against termites, the American cockroach, mosquito larvae, the housefly, screwworm, etc. Tests are being conducted under field conditions to determine its practical use, especially against the screwworm.

Dibromoethylbenzene (Styrene Dibromide), when tested in the laboratory was found to be effective against termites, etc.

Phthalonitrile, which is available commercially, is toxic to termites. It is being tried rather extensively in small-field tests for the control of several species of insects.

Ortho-, Meta-, and **Paranitrophenyl Iodochlorides** are easily prepared by treating the three isomeric iodonitrobenzenes with chlorine. They vary in their effectiveness against any particular insect, but one or more of the isomers was found to be toxic to the carpet beetle, the clothes moth, etc.

Dinitro-O-Cresol-Acetate was also found to be less injurious to foliage than was free phenol and to be toxic to insects. The compound was toxic to termites, American cockroach, etc.

Halogenated Acetanilides are very toxic to several species of insects, but the toxicity varies considerably, depending on the halogen involved, its position in the benzene ring, and the test insect. For example, orthochloroaecetanilide is fairly toxic to the clothes moth, the meta derivative is very toxic to this pest, but the para compound is ineffective. One or more of the compounds in this class are toxic to termites, the clothes moth, etc.

*Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington, D. C.—Published in Industrial and Engineering Chemistry (Indust. Ed.), V. 34, No. 4, April, 1942.

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Distribution of Arsenic in the Body of the American Roach

By RICHARD WM. FAY, *University of Illinois, Urbana*

THE economic entomologist is interested in the dosage of a stomach poison necessary to kill a certain percentage of insects within a given length of time. This method is satisfactory for the field but in the development of more efficient insecticides it is also desirable to consider the viewpoint of the physiologist to whom the lethal dosage is that amount of poison which must be absorbed from the gut into the body proper to produce death. Since the effectiveness of a stomach poison depends on the amount absorbed from the gut the present paper is a quantitative study of the passage through and the absorption of sodium metarsenite from the gut of the roach, **Periplaneta americana** (Linn.).

TECHNIQUE.—The American roach was selected because of size and ease of handling. Except for choosing equal numbers of each sex, the animals were chosen at random from groups of apparently healthy individuals. To minimize food material in the digestive tract each roach was supplied only water for 24 hours before.

The problem necessitated accurate technique and required (1) the feeding of known amounts of arsenic, (2) the dissection of the roaches at definite time intervals after feeding, and (3) the quantitative determination of arsenic in various parts of the body.

To feed known amounts of arsenic the roach was confined on its back in a metal tray by a sliding panel which fitted snugly around the cervix and without exerting pressure held the animal's head stationary. A sliding cover over the legs and abdomen minimized escape movements and the roaches usually remained quiescent during feeding.

A drop of sodium metarsenite was carefully forced onto the tip of a syringe needle. The syringe mounted on a ratchet and pinion was lowered until the drop contacted the roach's mouthparts and was quickly swallowed. This process was repeated until an approximate standard dosage of ten milligrams of solution containing 0.0963 milligram of arsenic was fed to each roach. Some variability was introduced by inability to control the size of the drops but since the total dosage was weighed to 0.05 milligram the arsenic fed was known with an accuracy of + or — 0.0005 milligram. All feeding was observed through a mounted lens and if the entire dosage was not swallowed or if regurgitation occurred, the animal was discarded.

The roach was weighed after feeding as it was not possible to determine accurately the body weight at the time of feeding. Loss of water vapor from the animal's struggles during handling and defecation during the feeding process produced significant and variable decreases in body weight.

At a definite time interval after feeding, body samples were taken for arsenic determinations. A blood sample was collected in a capillary tube from the severed ends of the coxae. A ligature of silk thread was placed around the animal's cervix. The digestive tract was exposed and ligated at the posterior end of the crop, proventriculus, ventriculus and large intestine. The digestive trace was then removed from the body and divided into sections by successive cuts just posterior to each ligature. Thus six samples—the blood, the crop, the proventriculus, the ventriculus and gastric caecae, the Malpighian tubules and intestine, and lastly the rectum were separated and placed in individual containers for chemical treatment. Three other samples were taken (a) the head and salivary glands, (b) the thorax exclusive of the legs, wings and gut, and (c) the abdomen including the fat bodies and reproductive organs but not the gut. These samples were also placed in separate containers. Each tissue sample was then digested in 50 per cent sulphuric acid and ground until all tissue was reduced to a fine state. Aliquot portions of these samples were used in the arsenic determinations.

The roaches were killed at one-half hour intervals after feeding. It was thus possible to trace the passage of arsenic in the gut and its absorption into the body.

Arsenic determinations were made by a modified Gutzeit method described by Fink (1927). Hydrogen, electrolytically generated in a 12.5 per cent sulphuric acid solution, combines with any arsenic in the test solution to form arsine. The arsine gas evolved at the cathode is reacted with 1.5 per cent mercuric bromide paper. This reaction produces an orange-brown coloration on a definite area of the paper strip and by comparison of the colored areas of the paper strips with those from known amounts of arsenic, the unknown solution can be evaluated with an accuracy of + or — 0.0004 milligram of arsenic.

Table 1—Quantitative distribution of arsenic in body samples from the American roach at one-half hour intervals after feeding. Standard dosage 0.0963 + or — 0.0012 milligrams of arsenic. Values are the means of individual determinations of twenty roaches for each interval.

	SAMPLE									
Time Hrs.	Crop Mg. Arsenic + or —		Provent. Mg. Arsenic + or —		Vent. Mg. Arsenic + or —		Intestine Mg. Arsenic + or —		Rectum Mg. Arsenic + or —	
0.5	.0941	.0016								
1	.0904	.0087	.0005	.0004						
1.5	.0913	.0017	.0011	.0008	.0003	.0003				
2	.0893	.0049	.0018	.0011	.0008	.0008				
2.5	.0855	.0043	.0034	.0012	.0033	.0019	.0002	.0004		
3	.0820	.0041	.0042	.0012	.0052	.0015	.0009	.0006		
3.5	.0785	.0043	.0043	.0012	.0074	.0016	.0016	.0007		
4	.0688	.0073	.0047	.0010	.0124	.0030	.0040	.0014		
4.5	.0621	.0064	.0047	.0009	.0173	.0026	.0051	.0011		
5	.0584	.0067	.0048	.0009	.0200	.0035	.0055	.0009		
5.5	.0512	.0074	.0050	.0009	.0221	.0031	.0067	.0010	.0001	.0001
6	.0459	.0066	.0052	.0008	.0253	.0027	.0074	.0009	.0002	.0001
6.5	.0413	.0053	.0051	.0007	.0277	.0021	.0079	.0009	.0002	.0002

APPLICATION—Ten males and 10 female roaches were used to determine the arsenic distribution at the end of each one-half hour period after feeding. It was necessary to continue the determinations to six and one-half hours at which time the majority of the animals had succumbed and further experiments were not feasible. If an animal died in the interim between two one-half hour periods the determination values were placed in the longer period. Separate determinations were made for each roach but to present the results in condensed form a mean value of the determinations values of twenty animals is given in tables 1 and 2.

RESULTS—Determinations on 260 adult roaches gave the following results. After administration of a standard dose of 0.0963 milligram of arsenic the mean arsenic value of the crop showed a gradual decrease from 0.0942 + or — 0.0016 milligram at one-half hour to 0.0413 + or — 0.0053 milligram at six and one-half hours after feeding. Arsenic was detected in the proventriculus 1 + or — 0.5 hour after feeding and rose to a maximum constant value of 0.0052 + or — 0.0007 milligram four hours after feeding. Arsenic appeared in the ventriculus 1.5 + or — 0.5 hours after feeding and rose to 0.0277 + or — 0.0021 milligram at six and one-half hours. Arsenic appeared in the intestine 3.0 + or — 0.5 hours after feeding and rose to 0.0079 + or — 0.0009 milligram at six and one-half hours. Traces of arsenic were detected in the rectum sample six hours after feeding but this arsenic may have been reabsorbed from the blood which showed traces of arsenic 4.5 + or — 2.0 hours after feeding. The arsenic in the head sample may have come from two sources (1) small amounts adhering to the mouthparts or remaining in the mouth cavity and (2) arsenic absorbed from the gut and carried into the head by the blood. Up to four hours a mean constant value of 0.0021 + or — 0.0014 milligram was recorded but after four hours the value rose gradually to reach 0.0045 + or — 0.0011 milligram at six and one-half hours. In the thorax and abdomen samples the arsenic appeared in 3.5 + or — 1.0 hours and rose to 0.0032 + or — 0.0007 milligram in the thorax and 0.0046 + or — 0.0009 milligram in the abdomen at 6½ hours after feeding.

Some arsenic was not accounted for and is recorded as error. The mean value of error ranged from —0.0008 to —0.0042 milligram of arsenic. This error may arise from the loss of small amounts of solution during the feeding process, from the loss of blood and other tissues during the disection, or from the handling of the samples in preparation for the quantitative determinations.

DISCUSSION—The results demonstrate that the crop wall of the living roach is not readily permeable to sodium metarsenite or some arsenic would have appeared in the thorax sample before three and one-half hours. This observation substantiated the work of Abbott (1926) who stated that the crop wall was impermeable to water and water-soluble substances. O'Kane & Glover (1935 and 1936) demonstrated that white arsenic penetrated the outer body wall of insects in about thirty-six hours and it is possible that arsenic would penetrate the crop wall also but in these experiments the rapid death of the animals prohibited any such observations.

The absence of arsenic from the proventriculus at the end of one-half hour is surprising in the light of Snipes' work (1938). He demonstrated that a banana paste containing white arsenic quickly entered the proventriculus but passed more slowly through the ventriculus. The semi-solid nature of banana paste may have modified the corrosive action of arsenic. The delay of proventriculus penetration suggests a certain degree of resistance to arsenic exists at this point.

It is in the ventriculus that the arsenic is apparently absorbed and after once penetrating the gut wall it is evidently carried to all parts of the body in a short time. The presence of arsenic in the blood indicates that this is a very probable means of transport.

At the time of death a survey of the head, thorax and abdomen samples indicates that from a dose of 0.0963 milligram of arsenic only 0.0105 milligram or approximately 11 per cent was actually absorbed from the gut to effect the kill. This means that the absorption of 0.0112 milligram of arsenic per gram of body weight will produce death in the American roach.

This study is one of basic research and its practical application is not immediate. A comparison between this study and studies on other arsenical salts or between different concentrations of sodium metarsenite should reveal factors which influence arsenic absorption and toxicity and should aid in the development of more efficient arsenical insecticides.—12-5-41.

Table 2.—Quantitative distribution of arsenic in body samples from the American roach at one-half hour intervals after feeding. Standard dosage 0.0963 + or — 0.0012 milligram of arsenic. Values are the means of individual determinations of twenty roaches for each interval.

Time Hrs.	SAMPLE Blood Mg. Arsenic + or —		Head Mg. Arsenic + or —		Thorax Mg. Arsenic + or —		Abdm. Mg. Arsenic + or —		Error (Tables 1and 2) Mg. Arsenic
0.5			.0014	.0011					— .0008
1			.0019	.0016					— .0042
1.5			.0022	.0014					— .0016
2			.0022	.0012					— .0019
2.5			.0027	.0014					— .0012
3	.0001	.0001	.0024	.0014	.0001	.0002	.0002	.0003	— .0019
3.5	.0001	.0002	.0023	.0012	.0001	.0002	.0005	.0005	— .0017
4	.0001	.0002	.0024	.0016	.0003	.0003	.0012	.0012	— .0018
4.5	.0001	.0001	.0027	.0011	.0008	.0007	.0019	.0010	— .0018
5	.0001	.0000	.0030	.0010	.0010	.0008	.0021	.0011	— .0015
5.5	.0001	.0001	.0037	.0011	.0020	.0010	.0033	.0009	— .0017
6	.0001	.0001	.0042	.0009	.0025	.0009	.0039	.0011	— .0015
6.5	.0001	.0000	.0045	.0011	.0032	.0007	.0046	.0009	— .0019

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—*Journal of Economic Entomology, February*, 1942.

Castor Oil Fly Killer

The drastic reduction of imports of certain chemicals used to kill insects has led du Pont chemists to devise a combination of castor oil and pyrethrum for household and cattle fly sprays. Experiments began ten years ago. Recently a base was discovered in what is called IN-930, an important constitutent of which comes from the castor bean. This new compound was accepted after 929 others had been rejected. Hence the name IN-930. The product not only takes the place of some pyrethrum but actually improves on it, it is claimed.

—*N. Y. Times.*

Pyrethrum vs. Roaches

(Continued from Page 13)

around the floor near the walls of a heavily infested room. Then dust the cracks or spray them with a pyrethrum-oil spray of high pyrethrin content. Escaping roaches would have to run through the mound of powder, insuring a lethal dose. This mounded band, if laid on paper, could be readily recovered and used again. Such barriers should be particularly valuable where automatic application of a fog of pyrethrum-oil by steam vaporizer or electric sprayer is employed. Merely fogging a room with pyrethrum-oil spray will not give perfect roach control. Recently Sullivan, Goodhue and Fales (1942) have experimented against roaches with an aerosol of pyrethrum oleoresin made by dissolving the oleoresin in Freon (dichlorodifluoromethane) and spraying the solution by pressure of Freon from a small steel cylinder. Good results have been obtained in a large hospital. This easy, safe and pleasant method of application will bear watching as it is developed further.

Treatment of single flat surfaces with a thin layer of pyrethrum spray or dust is of little or no value because the roach does not pick up enough to kill it and what insecticidal value the deposit has is soon lost.

In the above discussion the writer, like Dr. Back, is forced to rely on that indefinable background called experience, which is composed of laboratory data, opinions of pest control operators and observations of roach control practices. Likewise, when the editor of "Soap and Sanitary Chemicals" wanted to get some idea of the relative practical value of various roach powders, he had to rely entirely on the opinions of those to whom he sent questionnaires (Anon. 1940). Those opinions were probably derived from customer reactions. The consensus of opinion favored a mixture of pyrethrum and sodium fluoride.

Because everyone is guessing to some extent, the present writer's opinion may be faulty. Nevertheless his belief is reiterated that roaches can be controlled with pyrethrum alone and in no other way can roaches be controlled with greater safety to man and animals.

Summary and Conclusions

In preparation for research on the effect of pyrethrum on the locomotor activity of roaches, a survey was made of the literature on the action, testing and practical effect of pyrethrum on roaches. In discussing the action of pyrethrum on roaches, reference is made to its action on some other insects.

Against roaches pyrethrum acts as a contact insecticide. It does not act as a fumigant or stomach insecticide under conditions of use. Pyrethrum exerts a characteristic effect on the nervous system of roaches, resulting in muscular excitation, convulsions, paralysis and death or recovery depend on the dose. These effects on the adult female German roach result in premature dropping of the egg capsule.

Resistance of roaches to the effects of pyrethrum varies with age, sex, and species. Up to a certain age (probably the last nymphal instar) resistance increases, the adult female is more resistant than the adult male, and the larger species more resistant than the smaller. In the German roach, the eggs in the ootheca are more resistant to pyrethrum sprays than the females to which the oothecae are attached.

Suggestions are given for further research on the action of pyrethrum against roaches. Many problems remain to be solved in the field of physiology and toxicology.

The evalution of pyrethrum insecticides against roaches is described under the following outline:

Pyrethrum powder:
- Dusting of insects.
- Permitting insects to run over dusted surface.

Impregnated dusts:
- Dusting of insects.

Pyrethrum sprays:
- Individual insects—
  - Injecting, feeding, spraying, dropping.
- Groups of insects—
  - Direct spray and settling mist.

As more work has been done on the last item than on any other, it is likely that a finished method of evaluation will emerge first from a treatment of groups of insects with a direct spray or settling mist. The principle of spraying insects confined at several fixed locations under a fixed spray cone is most promising, because, with one treatment, graded doses can be deposited, each mean dose depending on the distance of each sample of insects from the center of the spray cone.

Experimental data on practical roach control with pyrethrum is nonexistent. A suggested procedure for obtaining such data is given. The use of pyrethrum in roach control is discussed on the basis of general experience. Because pyrethrum offers no hazard to man and animals and is effective against roaches when applied in sufficient quantity to the bodies of the insects, it is believed to hold an important and unique place among insecticides used for roach control.

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—Reprinted from Soap and Sanitary Chemicals, June, 1942.

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LOCAL ORGANIZATION NEWS

California PCOc Consider Unit Organization

Consolidation of all of California's PCO organizations into one state organization is now being considered, according to the CPCN, and tentative plans are being formulated by committees appointed by the following: Mr. William Hogan, president of the California Pest Control Association, Inc., Mr. David G. Rennie, president of the Associated Pest Control Operators, Inc., and Mr. Robert L. Loibl, president of Fumigators Association of Southern California. These committees are working out all details and as soon as the plan has been successfully approved by the committees, it will be submitted to the membership of each association for its final approval. A constructive educational program is being worked out in conjunction with the "Get-together" movement.

Bert Lahr, well-known comedian, following a slight earthquake the other night, complained, "My house is so shaky from earthquakes that every time a car rolls by outside, the termites have to hold hands to keep the building from falling down."—C.P.C.N.

A Pious Father's Philosophy: "My son, never speak unkindly of price cutters. Never knock them, because God made price cutters, my son. He made them the same as He made snakes, lice, bugs, polecats and politicians. In His inscrutable wisdom He made them. Why He made them only He knows—I'll be damned if I do."—C.P.C.N.

E. R. Bellemare, B.A., L.Sc., Nominated Professor of Entomology: E. R. Bellemare, who has been associated with the Montreal office of the Mysterious Chemical Co., Ltd., as Sales Manager since 1934, and as Technical Director since 1940 when he graduated in Entomology, was recently nominated Professor of Entomology at the Biology Institute of the Universite' de Montreal. Professor Bellemare, who obtained his L.Sc. degree with high honors last June, will retain his post of Technical Director with the Mysterious Chemical Co., while teaching entomology. Congratulations!

About Spiders: In his talk "Some Common Misconceptions About Spiders" before the Georgia Entomological Society, Emory University, April, '42, Dr. B. J. Kaston, of Brenau University, pointed out that not all spiders spin webs, that the female in only rare cases ever eats the male, that not all spiders are dangerously venomous, that spiders suck not only the blood of their prey but also the solid tissue after they have been predigested by proteolytic enzymes injected in the venom of the spider.

18th Annual Convention of the National Shade Tree Conference was held August 25, 26, 27, 1942, at the LaSalle Hotel, Chicago, Ill. Discussions geared to the war-time emergency featured the program.

Children in Mexico are sometimes given a cough medicine made by grinding up small insects called "ant lions." (Come, be a nice boy, Miguel, and take a spoonful, now.)
—*Neil O'Hara, N. Y. Post.*

Biggest Demand for fly paper and insect sprays is from troops stationed in Southern climes. Despite strict sanitation methods there is still a need for these well-known fly destroyers.

Proceedings—North Central States Entomologists: The report of the North Central States Entomologists meeting, held at Urbana, Ill., March 26, 27, will soon be available. As long as they last, copies can be obtained at 75 cents a copy by writing Prof. W. P. Flint, Natural Resources Building, Urbana, Ill.
—*Crop Protection Institute Circular.*

Cueing his promotional literature to the war effort, Dave Blaker, Southwestern Exterminator, Amarillo, Texas, has issued an "OPEN SEASON — JAP HUNTING LICENSE," which, in effect, entitles holder to hunt down and destroy any male citizen of the Rising Sun Empire. Anyone, wishing to be enrolled in this worthy cause, can obtain a duly authenticated "Jap Hunting License" from Dave, "Chief Game Warden of U. S. Took Tokyo."

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Wood-Boring Habits of the Drugstore Beetle

E. Gorton Linsley

A number of authors (Stebbing, et al., 1914) have attributed wood boring habits to the drugstore beetle but all too frequently the identifications have been open to question. However, injury to books, especially to covers containing glue, paste or casein, as is well known (Back 1939). Dorn (1921) and von Lengerken (1922) have noted damage to leather trunks. It may therefore be of interest to record a recently observed case of wood boring by this insect.

In 1924 a mah-jongg set manufactured in China was purchased in San Francisco. The game was utilized for a year or two and then stored away and left untouched until 1941. At that time it was noticed that the bamboo playing pieces had been severely damaged by anobiids. The larvae had injured about 80 per cent of the pieces and in every case the boring was confined to the bamboo which was in contact with the back surface of the ivory face. Some damage was also evident in the unpolished back surface of the ivory. Apparently, as in the case of injury to books and leather trunks, the larvae had been attracted by the glue which was used to fasten the ivory face to the bamboo. The larvae were caged and reared and proved to be the drugstore beetle, **Stegobium paniceum** (Linn.).

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—*Journal of Economic Entomology June, '42.*

Chiggers, Jiggers Differ

Chiggers and jiggers, both very annoying "bugs," are not at all the same thing, Major John E. Weigel, Army surgeon, points out in an issue of the Infantry Journal. Chiggers are the larval form of ground-dwelling mites, that invade the human skin during a certain stage of their growth. Jiggers are true insects, better known perhaps as sandflies. They are bloodsucking biters, and the females, exceedingly tiny pests, are also skin-invaders when they have families to raise.

Both chiggers and jiggers can be repelled with sulphur, applied to the skin before going into places haunted by the pests. Direct use of powdered sulphur is inadvisable because it is very likely to cause skin irritation itself. Sulphur mixed with various kinds of ointments and vanishing creams has been tried with success.

—*N. Y. Times.*

Qualified:

I expected the exterminator man and later that day a doctor was to call to give me a physical examination for an insurance policy. I did not know either one of them and when the bell rang and a young man appeared, I asked him if he were the exterminator. "No," he replied, "I am the doctor, but some people might call me an exterminator."

—*Embarrassing Moments in N.Y. Daily News.*

He who saves the boss' time, into the boss' chair will climb.

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In the meantime we can only assure Pyrethrum users that they will be served to the best of our ability and that ever-present difficulties have not threatened the maintenance of our quality standards.

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War Stimulates Tests of Insect Poison

Wartime dislocations of the sources of supply of some insecticides has intensified research on substitutes. But some promising substitutes already worked out in laboratories are not on the market because they have not been tested widely enough to warrant commercial production. To cut down this lag, R. C. Roark of the U. S. Department of Agriculture, is now writing a series of mimeographed reports to entomologists—not to the general public—on "Some New or Little Used Insecticides Worthy of Further Testing." The chemicals he mentions are not, as a rule, on the market, and so are not practical even for experimental use by farmers and gardeners. Roark is offering these reminders with the idea that as soon as the chemicals have been tested widely enough, industry will supply the best of them.

Delay in getting insecticides into action is an old story. Derris, says Roark, was mentioned as an insecticide as early as 1848. A 1919 report was favorable. But it did not come into quantity use in the United States until 1931. Now the rotenone insecticides — manufactured mainly from derris—are widely used, and with much of the supply cut off, the WPB has restricted use of rotenone to the more essential food protection purposes for which there is no substitute. The very fact that shortages now exist will stimulate wide testing of promising substitutes, Roark believes.

In the first papers of this series for entomologists, Roark reminds them of recent research in the Bureau of Entomology and Plant Quarantine that has developed a whole series of copper and arsenic compounds closely related to Paris green. Paris green is made with the aid of acetic acid. By substituting some of the other similar acids, F. E. Dearborn has created related "greens," some more poisonous to certain insects than the original poison. Also in combination with some of the oily acids—from peanut, soybean, tung, and fish oils—the "greens" have been highly effective against some insects.

A New 76-Page "Fumigation Manual"

Designed as a reference book for the pest control operator, has been published by the Electrochemicals Department of E. I. du Pont de Nemours & Company.

Fumigation with hydrocyanic acid gas of homes, industrial structures, mushroom houses, museums, railroad equipment, passenger buses, flour mills, candy factories and stores, warehouses and other places where insects cause damage is described in the manual.

Fumigation procedures, the generation of the fumigant, and fumigation in atmospheric and vacuum vaults are detailed. The manual also contains a descriptive list of insects, and references to information on the effects of hydrocyanic acid gas on feeds, fabrics, metals and other commodities, fumigation precautions, first-aid and medical attention, fumigation records and "selling pest control."

Copies of the manual will be sent by the Electrochemicals Department of the Du Pont Company, Wilmington, Delaware, to pest control operators requesting it on their business letterheads.

Japanese Beetles—And Men

They lay their eggs within our country's soil.
The grubs emerge like corpse-worms sickly gray.
They eat the tender roots, destroy and spoil—
All growing things become their helpless prey.

Now they have wings—their legions come to light.
They strike at helpless trees; destroy, devour
The living green of leaf. They blast and blight
And ravish to the death the fairest flower.

So we must crush them to their fated doom;
Fight, kill and trap until this evil pass.
Then lovely flowers may grow again and bloom
And dewdrops glisten on the young new grass.

—Harry Varley.
—*N. Y. Sun.*

Of Mice and Men

Portland, Ore.—Norman Cahill, plagued by rats in the family garage, built a fire to smoke them out. The rats left. So did the fire department.

—*N. Y. World-Telegram.*

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Attack of the Lead Cable Borer on Asphalt Roofing Material

E. Gorton Linsley

Some of the remarkable boring habits of the lead cable borer, **Scobicia declivis** (Lec.), are well known (Burke, et al., 1922). However, one interesting reaction of the species has recently come to the attention of the writer which does not seem to have been recorded previously.

Recently a large comercial building in San Jose, Calif., encountered difficulty with a leaking roof. An examination revealed that the asphalt roofing material, covering the concrete slabs of the roof itself, was full of holes made by the lead cable borer. The roofing material was composed of four layers of No. 15 asphalt-saturated rag felt mopped solidly with asphalt between each layer, with a cap sheet of No. 90 mineral surfaced roofing mopped with hot asphalt. The beetles bored in at right angles to the surface and penetrated the material until they reached the concrete. The burrows were most numerous near the metal counter flashing beneath windows but were also found distant from any materials of this nature. There was no evidence that the beetles ate the asphalt since the boring dust was pushed out of the burrows as the beetles progressed.

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—*Journal of Economic Entomology June, '42.*

Rules to Avoid Accidents in Pest Control Work

1. All workmen should use gloves when handling chemicals and electric equipment.

2. When spraying, dusting chemicals, or doing dusty work, clean respirators should be used.

3. No smoking should be permitted during working hours except at noon period or rest periods, and then only when away from the building under service.

4. See that no gas is escaping from leaking pipes or no live electric wires are free in working areas.

5. Provide well constructed scaffolding where needed. Do not take chances with only one nail to hold a plank.

6. Provide employees with sharp tools, plenty of light to work with, and see that electric light cords are hung up away from dampness and wet chemicals.

7. No intoxicants should be drunk during working hours — not even a glass of beer for lunch.

8. In grinding and sharpening tools, glasses should be worn over the eyes to protect them.

9. All necessary precautions should be provided to avoid accidents from falling objects, such as tools, loose plaster, scaffolding, etc.

10. Keep good brakes on all trucks and service cars.

11. In fumigation, all men should be provided with masks, ammonia crystals, and rubber gloves, and "what to do" and "how to do it" should be part of his instructions.

12. First aid kits should be carried in the working equipment of each employee and he should be instructed in First Aid knowledge of accident prevention.

—*California Pest News.*

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Manufacturers of Pest Control Chemicals

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Items of Interest

Nature

A woman friend of ours who has a garden apartment also had ants a while back. She got on the telephone, and presently an exterminator man appeared briskly with a flashlight and an ominous little black bag. The two of them looked for the ants, but they had gone. "I'm sorry," said the lady, and was surprised at the chagrin in her voice. "They were here. There were really millions of them." "That's all right, Ma'am," the exterminator man answered in a resigned fashion. "That's the way ants are—very undependable."

—*New Yorker Magazine, July* 25.

Hunt Cave Mosquitoes

Members of the New England Spelunkers' Grotto—cave explorers to you—apparently don't think there are enough mosquitoes in the world. At the behest of the U. S. National Museum the Spelunkers explored Skinner's Cave on Mt. Equinox in search of new specimens of cave mosquitoes.

—*N. Y. World-Telegram.*

Epidemic Experts Aid Hitler

Two epidemic research experts have been attached to Reichsfuehrer Hitler's field headquarters in addition to his personal medical staff, according to reports received in Berne, Switzerland. The experts are directed to investigate means for avoiding spotted fever and other epidemics to which German troops are exposed along the Russian front.

Misses Squirrel

Memphis.—An 11-year-old Memphis boy was arrested here for shooting a firearm inside the city limits. The lad was brought to Juvenile Court after he fired his 22-rifle at a squirrel—and killed a mule.

—*N. Y. World-Telegram.*

Mite Control Pays

Mite control comes under the heading of good poultry management. In Illinois farms where records were kept by owners and analyzed by college extension folks, the flocks that had no mite control treatment returned $164 for every $100 invested; in flocks with mite control, the return was $200 for every $100 invested. Carlolineum, used once a year, keeps mites in check.

—*Farm Journal, July*, 1942.

Members "Household and Industrial Insecticide Manufacturers' Advisory Committee," War Production Board

Government presiding officer: W. H. Moyer, principal industrial specialist in charge of insecticides and fungicides of the agricultural chemicals unit.

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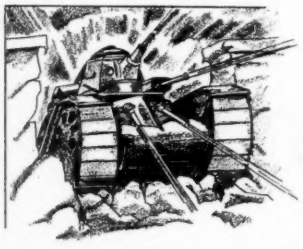
J. Powell, John Powell & Co., New York.

G. W. Williams, George L. Williams Co., Cleveland, Ohio.

W. J. Zick, Stanco, Inc., New York City, N. Y.

Pigs With Wings

One female moth and her descendants, states Neal O'Hara in the N. Y. Post, if left unmolested, in a single year can destroy as much wool as 13 sheep could produce in the same period.



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In MOTH Work, for example: LARVACIDE penetrates deep upholstery, blankets and other woolens; gets in back of wall paper and into floor cracks and crevices that might afford refuge from fumigants less penetrating. It kills the moth eggs along with larvae and adult insects. Tough problems are not so tough when you use LARVACIDE. Write for literature on Industrial and Home Fumigation. When you have a particularly mean nut to crack, write us for our experience.

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512 East 14th St. Kansas City, Mo.

WHAT'S NEW IN PEST CONTROL-PERSONALS

Lt. W. E. "Mac" McCauley Father of a Daughter; Immediately Arranges for Match With Ken Cook's New Son . . . George Lay Buys Semi-Farm:

On July 31, shortly after being commissioned a first lieutenant and stationed at Camp Edwards, Mass., Mac, former manager Insecticide Division, Velsicol Corp., Chicago, became the proud papa of a daughter, christened Janet Lou. Congratulations to the McCauleys and may you all be reunited soon. Florence, the baby's mother, we are told, "took it" like a major, but Mac being only a first lieutenant wasn't able to "get around" so well till the next day—though come to think of it, that is not so bad as fathers go—when he was taken in tow by New England's "USO" George R. Elliott, who helped Mac to loaf on leave as intensively as possible, delivered him back to camp sober and otherwise sound. On the way there they stopped in to see George Lay, and family, who has bought a semi-farm in Hopkinton, Mass., which town, by the way, is between Worcester and Framingham if you're ever up that way. Mr. Lay was busy remodeling his place and had no idea his whereabouts was known until the fellows dropped in. George reports a most enjoyable visit.

Incidentally, says George, Mac has already arranged for a match between his daughter born July 31, and Ken Cook's new son—who is also George's nephew—born July 16, which just about makes it perfect since, as we understand it, the man should always be older than the girl he expects to marry.

War-Effort Editorials: M. A. Sanderson, Mgr., Reliable Exterminators (Reg'd), Toronto, Canada, whose commendable home town patriotic endeavors were reviewed in a previous issue, has followed through in newspapers of that city with three more trenchantly worded editoralized advertisements, at his own expense. Some inkling of the text of these may be gleaned from their headings which follow: WILL TONIGHT'S BLACKOUT PROVIDE ANOTHER FROLIC FOR NIT-WITS AND HOODLUMS; GERMANS OR VERMIN(S) EXTERMINATED—It's All the Same to Us. We've Worked on Both and Know How to Give Either One the "Works"; WELL, GOOD-BYE, SON—GOOD LUCK AND GOD BLESS YOU . . . PCOs may obtain reprints of Mr. Sanderson's patriotic pep-talks by writing him. They are well worth reading.

Mohandas K. Gandhi, whose life has been one of bodily privations, is installed under British arrest in one of the world's most luxurious palaces, the home of the Aga Kahn. Despite surroundings dominated by Persian rugs, beautiful paintings and other Oriental luxury, Gandhi was dissatisfied with the mosquito netting on the veranda, and it was changed at his request.

The 35th for the Elmer Roberts—Elmer and Florence Roberts of Burlingame, Calif., celebrated their 35th wedding anniversary the early part of August. 'Tis said that among the festivities was the big dinner at Grison's Chicken House in San Francisco, Calif. Congratulations from your many friends. Will see you on the 50th.

Mr. and Mrs. Walter S. McCloud of Chicago enjoyed a sojourn of ten days of Sportsland Valley Lodge, Winter Park, Colorado. 'Tis said that many more photographs will make up a handsome addition to the splendid collection Walter has now.

Robert E. Hackley's Son, who majored in electrical engineering at Stanford Univercity, Calif., graduated there the fore part of this summer. While at college, Bob's son also taught a laboratory class in elements of radio for defense, which avocation it is his intention to continue. Congratulations, Bob, to you and your son.

Rotenone and Pyrethrum: Mr. Harold Noble, Manager, Insecticide Division, S. B. Penick & Co., New York, at the request of the New York Herald Tribune, prepared an article on the current ROTENONE and PYRETHRUM situation which appeared in that newspaper on July 19, 1942. It discusses, among other things, use of these insecticides by the armed forces, war-time restrictions with regard to gardeners' use, etc. No doubt Mr. Noble will be glad to supply copies of his article, as long as his supply lasts, to those who write him.

PCO Changes Firm Name: Arthur B. Tronsen, Prop., A. Armitage Extermination Co., formerly at 2633 W. Armitage Ave., Chicago, Ill., will henceforth be known as the A. Armitage Pest Control, not inc., and is now in business at 3618 West North Ave., that city. Best of luck, Mr. Tronsen, in your new set-up.

Silver Wedding Anniversary: Industry standby, John Potts Linn, of Omaha, and Mrs. Linn celebrated their 25th wedding anniversary on June 27. The Hahnes and the Levensons helped them to celebrate the festive occasion. More power to the Linns, and let's hope we may also have the pleasure of reporting their golden wedding anniversary. Congratulations!

And Speaking of Anniversaries: Mr. and Mrs. Lother Vogel of Brooklyn, New York, celebrated their 21st wedding anniversary on July 31st. Mr. Vogel is owner of the Atlantic Exterminating and Fumigating Co. of Brooklyn. Yes, sir, Helen and Bill Buettner on August 7th celebrated their second anniversary. The big one is coming in November when it is hoped to celebrate the golden wedding anniversary of "Ma" and Bill Shrimplin of New York.

Apes Behave Like Humans: In her book, "Animals Are My Hobby," published by Robert M. McBride & Co., New York, Gertrude Davies Lintz reports a certain element of human disgust comes into the ape's feelings about rodents. One of her intelligent chimps, Suzabella, learned to kill mice and rats, but she would rather die than touch them. She would wait until the intruder was hidden under the brown paper on the floor of her cage, and then pounce on it and kill it with a powerful blow of her fist. Then she would rap up the corpse with averted face, and throw it out of her cage with loathing—*believe it or not.*

Mice Milked: With the aid of a special device for the purpose, the National Institute of Cancer Research at Bethesda, Md., milks mice on regular schedule. The mice are used in experiments to ascertain if milk plays a part in the transmission of cancer from one generation to the next, and if so the nature of the agent in the milk that carries the cancer. Incidentally, a mouse gives seven-tenths of a centimeter of milk a day, which is about equal in volume to the tip of a woman's little finger as far as the root of the nail.

—*New York Herald Tribune.*

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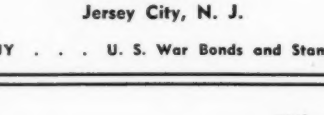
Will Give Long Constant Service - 8 Oz. Capacity



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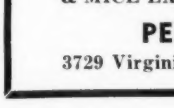

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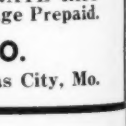

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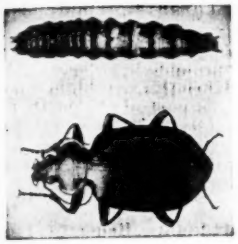
Know insects and how to control them

HERE is a soundly scientific introduction to the study of insects, particularly in their relation of man, that provides a thorough introduction to the facts that are important to readers concerned with the destructiveness of insects, their harmfulness economically and the means of controlling them. This newly revised book is brought completely up to date to include important recent advances in the field.



Just Out!

APPLIED ENTOMOLOGY

By H. T. Fernald
Emeritus Professor of Entomology, Massachusetts State College; Onetime Entomologist of Massachusetts Agricultural Experiment Station

and Harold H. Shepard
Assistant Professor of Entomology, University of Minnesota

Fourth edition
400 pages, 6x9
383 illustrations
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Quickly Gives the main facts you want about:

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In exceptionally clear, simple form this book gives a complete but concise treatment of insects. It covers their structures, life histories, and habitats generally, and also deals separately with the distinctive characteristics of all the most important orders and families. It introduces the reader to the broader aspects of insect damage and insect control and also tells in more detail and methods best controlling each of the different types of insects.

Gives full practical treatment of control methods

In this new edition are later findings on the relationships of insects, new insecticides that have proved effective, etc. Insecticides and fumigants, what they are made of and how they work, are covered in two separate chapters, and more details on when and how to use them are given in connection with the discussions of the various orders and families of insects. Besides these and trapping and other artificial methods, the book also covers the part of insect parasites, crop rotation, and other natural means in controlling insects.

McGRAW-HILL PUBLICATIONS IN THE AGRICULTURAL SCIENCES

PESTS, and their Control
512 East 14th St.
Kansas City, Mo.

Standard Textbook on Entomology Brought Up to Date

If it isn't always possible to do something about the critical shortage of "control chemicals" in these perilous days, it is possible—in fact, it is more important than ever—to broaden one's scientific knowledge of the nature and habits of structural-type insects, the chief means of controlling them, the details of each order, its harmfulness, if any, and specific control measures. All this and more is made available in the new fourth edition of "APPLIED ENTOMOLOGY," by H. T. Fernald, Emeritus Professor of Entomology, Massachusetts State College, one-time Entomologist of Massachusetts Agricultural Experiment Station, and Harold H. Shepard, Assistant Professor of Entomology, University of Minnesota. 400 pages 6 x 9, 383 illustrations, $3.50, McGraw-Hill Book Co.

This volume is a soundly scientific introduction to the study of insects, in exceptionally clear, simple form which covers their structures, life histories, and habitats generally, and also deals separately with the distinctive characteristics of all the most important household and agricultural-type orders and families.

In revising this well-known text, which has been a standard since 1921, the authors have included much new material in order to bring the book completely up to date with regard to life histories, habits, control methods, etc. Several chapters have been entirely rewritten and the material of others rearranged to present the latest ideas on the subjects under discussion. One of the features of the revision is the special attention given to modern methods of control, including a treatment of the newer insecticides, fumigants, what they are made of and how they work, with details of how to use them. Besides these and trapping and other artificial methods, the book also covers the part of insect parasites, crop rotation, and other natural means in controlling insects.

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INSECTICIDES

Sanitary Chemicals catalog recently issued which contains special section on insecticides such as: Roach Powders; Liquid Roach Spray; Bed Bug; Odorless Insecticides; Fly Sprays; Pyrethrum Sprays; Moth Sprays; Ant Insecticides; Rat Poisons; Rat Bait; Mill and Warehouse Sprays, etc. Also has special sections on: Disinfectants; Deodorant Blocks, Waxes, etc. Of particular interest to concerns interested in private label packaging.

WRITE PESTS—BROS.

RAT CONTROL AND THE WAR

Circular discusses the importance of adequate rat control to further the war effort.

WRITE PESTS—AC.

ARSENICAL TERMITE CONTROL AND WOOD PRESERVATION

Circular discusses Sodium arsenite for use in certain types of termite control and it is claimed especially adapted for foundation timbers, upright timber set in the ground such as posts, poles and studding. Methods used. Treatment of horizontal timbers such as sills, etc. Wood preservative qualities.

WRITE PESTS—Niagara.

GARDEN SPRAY GUIDE

Contains a primer of simplified pest control. Discusses garden insects; plant diseases foraging pests. Describes garden pests; quick reference pest control chart. Illustrated.

WRITE PESTS—Ortho.

PARADICHLOROBENZENE PRODUCTS

Circular describing bowl deodorant with aluminum wire hanger; bowl deodorant with wire hanger; moth vaporizer; microphone moth vaporizer; moth vapor bomb; vaporizer refill; paradichlor nuggets or crystals, etc. Write Greenpoint, c/o PESTS.

INSURING FUMIGATION RESULTS

Bulletin advances some valuable suggestions which should prove of constructive interest for the fumigator.

WRITE PESTS—AC60.

ROACH POWDER DUSTER

Made of brass and will stand all kinds of hard usage according to inventor. Saves on powder, time and energy and is made so you can handle the average building from the floor to the ceiling without getting down on your knees or using a stepladder, it is further claimed.

WRITE PESTS—KEYSTONE.

TARPAULIN FUMIGATION

Folder discusses: Tarpaulin fumigation for bagged and packaged foods and agriculture seeds; procedure; how to arrange the gas expansion dome; how to cover stock for fumigation, etc.

WRITE PESTS—TARPAULIN-D.

Hydrocyanic Acid Not Cumulative:

Bulletin attempts to answer such questions as: What after-effects result in the case of a person who has been overcome by hydrocyanic acid and is subsequently revived?—Does the gas have any cumulative effect upon a person who unavoidably breathes small quantities of it in the course of his daily work?

WHITE PESTS—AC-61

PLACARD-FUMIGATION SAFETY RULES

Placards (14"x22") outlining fumigation, safety rules, general rules and precautions, data on gas masks, first aid and antidotes. Of importance to every pest control operator. Available to pest control operators doing fumigation work.

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Free copy of pamphlet mailed free to interested pest control operators and insecticide manufacturers. Write PESTS—McLaughlin.

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Manufacturer claims many new features such as no turning or twisting necessary; four openings; larger trap; contents ⅓ greater than any other competitive brand.

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REFERENCE MANUAL FOR MILL AND WAREHOUSE FUMIGATIONS

Manual discusses: How to prepare the mill for fumigation; proper dosage; how to apply methyl bromide in the flour mill; what to do about winter fumigations; proper venting; warehouse fumigation piping system for mill and warehouses; how to operate methyl bromide cylinders; important precautions; other uses for methyl bromide fumigation, etc.

WRITE PESTS—MANUAL-D.

Entomological Literature

BROMIDE RESIDUES IN CEREALS FUMIGATED WITH METHYL BROMIDE

By L. S. Roehm, S. A. Shrader, and V. A. Stenger, The Dow Chemical Co., Midland, Mich.

Summary: It has been shown that the bromide retained by cereal products following fumigation with methyl bromide exists almost entirely in inorganic form after standing for a few days, and, furthermore, that the amounts retained are likely to be smaller in commercial fumigations than in laboratory experiments.

The retentions of bromide by different cereal products have been compared. Most commercial cereals retain only small amounts.

The influence of relative humidity on the retention of bromide by wheat products has been studied briefly. At higher humidities water displaces part of the methyl bromide from the surface, but the methyl bromide which is taken up reacts more rapidly to form inorganic bromide.

A List of Plants Reported to Contain Rotenone or Rotenoids: By Howard A. Jones, Division of Insecticide Investigations, U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, Washington, D. C.—E1571—June 1942.

Following Japan's exaggerated claims from her attack on the outlying Aiaskan Islands, WINS, New York radio station, intimated that Japan was suffering from "Aleutianations." Outch!

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--BOOKS--

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Chemical Formulary, Volume V

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The formulas are those used in commercial concerns and have been collected through the efforts of a board of editors of 45 outstanding chemists. These editors, most of whom are connected with commercial firms, experiment stations or American colleges and universities, add considerable authority to the book.

The ground covered in this volume is more comprehensive than that of any previous one and the editor has done an excellent job in this compilation. In a ready reference and brief form he has placed before the layman as well as before the specialist, much information that might otherwise necessitate a great deal of time to ferret out.

The book is not one of formulas alone, but is written in a crisp and intensely interesting explanatory fashion which enhances its value to any private or industrial library. The fact that many practicing chemists engaged in one field of work are not familiar with the formulas in another field, and that much study and practice must go into compiling unfamiliar formulas makes this volume a ready source book of information.

Of special interest to the readers of this journal would be the chapter devoted to FARM AND GARDEN SPECIALTIES. In addition to these subjects the following are discussed in great detail: ADHESIVES, BEVERAGES, COSMETICS AND DRUGS, EMULSIONS AND DISPERSIONS, TEXTILES, FIBRE, SOAPS, CLEANERS, FOOD, INKS, LEATHER, SKINS, FURS, LUBRICANTS, OILS, FATS, MATERIALS OF CONSTRUCTION, METAL AND METAL TREATMENT, PAINTS, ENAMELS, VARNISHES, LACQUERS, PAPER, PHOTOGRAPHY, POLISHES, PYRO-TECHNIQUES AND EXPLOSIVES, RUBBER, RESINS, PLASTICS, WAXES, MISCELLANEOUS.

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An indexed reference book produced by the University of California Termites Investigation Committee of engineers, scientists, and business men in six years' collaboration.

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This book discusses primarily the problem of preservation of shade trees from insect pests also describing accepted methods of fertilizing shade trees. It is intended for pest control operators engaged in the business of treating and caring for shade trees, and for all others interested in preserving shade trees. The book discusses in detail all the important insect enemies of shade trees east of the Rocky Mountains, and most of those on the Pacific coast. The book is illustrated with 350 photographs and drawings. Contains 417 pages. **Price, $5.00.**

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SAN JOSE STATE COLLEGE

In this new book the authors give a general view of a vast and fascinating world.

Comparatively brief and nontechnical, the book reviews the many fields upon which the insect impinges, discussing such topics as insect structures, how insects grow up, insect food and feeding habits, insect food-getting devices, how insects reproduce themselves, how insects get air, how insects move, how insects are protected, insect voices, insect fitness, insect orders, social life among the insects, the value of insects, injurious insects and their control, where to look for insects, rearing insects, and how to collect and preserve insects.

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During recent years, the study of insect pests has received an increasing degree of attention, which is in every way justified when the effects produced by this type of nuisance is taken into consideration. This has resulted in benefit to the community. The foundation of successful vermin destruction is an accurate knowledge of the habits, life history and environment of the insect in question. It is only when this problem has been properly tackled and thoroughly understood that the chemical and mechanical means of combating pests can be utilized.

The authors have assembled a vast fund of practical information within the confines of a small handbook, which should be of great value to those who are called upon to play some part in insect control during the present emergency. Now when so many thousands of our men are brought together in training quarters, that which was formerly considered a nuisance has finally been recognized as a definite menace. Every war introduces problems in this particular line of activity and the authors have kept this fact before them in preparation of the material for INSECT PESTS. Because of this view point, this book is of special importance at this time.

Part I deals with Insect Pests, including the bed-bug, the flea, the louse and other vermin. Part II is devoted to the Principles and Practice of Disinfestation, including building construction and infestation, gaseous fumigants, technic of fumigation, educational measures for insect control, legislative control, human toxicology, and the disinfestation of foodstuffs and ships. There are two appendices containing forms and records and specimen propaganda leaflets; the book is well indexed and is attractively printed and bound.

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MORTICIDE

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However,

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